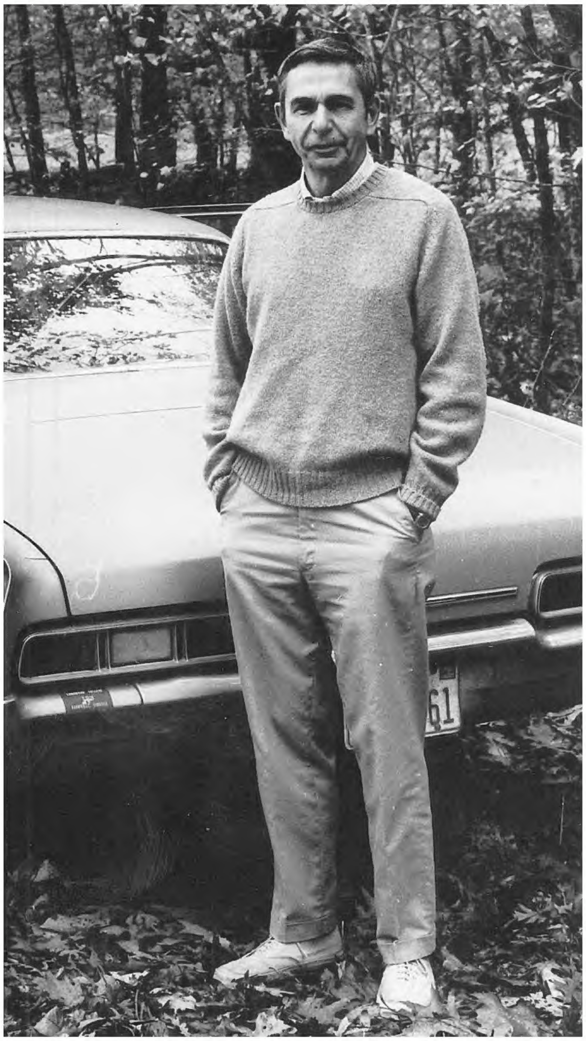
BANISTERIA

A JOURNAL DEVOTED TO THE NATURAL HISTORY OF VIRGINIA



Charles E. “Mo” Stevens, Jr.
(1926-2015)

A tribute to one of the finest amateur naturalists in Virginia during the past century, who was a major contributor to regional herbaria and coauthor of three atlases documenting the geographical distribution of plants in the Commonwealth, appears on pages 38-48 of this issue.

Number 46 ISSN 1066-0712 2016

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ISSN 1066-0712

Published by the Virginia Natural History Society

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Banisteria No. 45 was published on 11 February 2016.

Cover: Charles E. “Mo” Stevens, Jr. (December, 1975); modified from original photo by Doug Ogle.

Back cover: *Primula meadia* (Linnaeus) A. R. Mast & Reveal (Eastern Shooting Star). Original drawing by John Banister. Figure 42 in folio in Hans Sloane’s MS 4002 in the British Museum of Natural History. Photograph courtesy of Joseph and Nesta Ewan.

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Banisteria, Number 46, pages 3-11
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Herpetofaunal and Small Mammal Assemblages Along a Terrestrial Moisture Gradient in Northern Virginia

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ABSTRACT

We studied the composition of terrestrial amphibian, reptile, and small mammal assemblages in five types of forested habitats in Prince William Forest Park (PWFP) in northern Virginia ranging from hydric to xeric moisture regimes. We used drift fences and pitfall traps to capture 1,099 individuals representing seven species of anurans, seven salamanders, three lizards, four snakes, four shrews, and four rodents. The wetter floodplain and mesic sites supported significantly higher numbers of amphibians than the three drier sites (mixed, oak, pine). Numbers of *Plestiodon fasciatus*, the only reptile captured in abundance, were not significantly different among all five sites. Number of captures of three species of mammalian insectivores documented at all five sites did not differ significantly. No rodent species was abundant on these sites, although more *Peromyscus leucopus* were captured than other species; it occurred most often in the mesic site. The pine (xeric) site had the fewest species and the lowest number of individuals of all the vertebrate groups. The regenerated forest in PWFP should allow long-term persistence of the herpetofauna and small mammals characteristic of this region.

Key words: Amphibians, community ecology, forest ecology, reptiles, restoration, small mammals, Virginia.

INTRODUCTION

The Coastal Plain and Piedmont regions of the mid-Atlantic have been included traditionally as part of the Oak-(Hickory)-Pine Forest Region, with oaks and hickories comprising the climax community (Braun, 1950; Kuchler, 1964; Skeen et al., 1993). Although accuracy of this designation has been questioned (Monett & Ware, 1983; Ware, 1991) and other types of designations have been proposed (e.g., the ecosystem approach, Bailey, 1995; Ricketts et al., 1999), the fact remains that little to no old growth forest existed in this area for over a century. Elimination of original forests by agriculture, logging in the 1800s and early 1900s, urbanization, and logging in the 20th century have left only patches of forest in varying stages of ecological succession (Godfrey, 1980). Where forest regrowth has occurred on abandoned lands, the result is a mix of forest types ranging from pine on xeric sites to upland hardwoods to mixed hardwood communities in mesic and riparian sites. These forest types provide diverse environments that support mixed assemblages of terrestrial vertebrates. Species richness and relative abundances of these assemblages vary among forested and non-forested habitats and over a range of geographic areas (Kirkland, 1990; Bellows & Mitchell, 1999; Mitchell, 2014).

On Shenandoah Mountain, Virginia, high elevation amphibian and small mammal assemblages vary significantly among clearcut, pine, mature, and old growth forest habitats (Mitchell et al., 1997). In central Virginia, small mammal assemblages show higher species richness and greater abundances in oldfield habitats than in hardwood forests (Pagels et al., 1992). Amphibians exhibit the opposite relationships in the same area (Mitchell, 2014). These and other studies (e.g., Buhlmann et al., 1993; Erdle & Pagels, 1995; Bellows & Mitchell, 1999) demonstrate that there is considerable geographic variation in the structure of terrestrial vertebrate assemblages in intact and altered forest ecosystems in the mid-Atlantic region.

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We studied the composition of terrestrial amphibian, reptile, and small mammal assemblages in five different types of forested habitats in a national park in northern Virginia. The forests in this national park are unlikely to be subjected to silvicultural practices typical of private, commercial, and military lands where there are active forestry programs. Our objective was to elucidate the structure of these vertebrate assemblages along a moisture gradient ranging from a moist floodplain forest to a xeric pine stand. We hypothesized that there would be fewer species in the driest habitat and that alpha diversity and numbers of individuals would vary among all habitats.

MATERIALS AND METHODS

Study Sites

We established study sites in five different forest types in Prince William Forest Park (PWFP), Prince William County, Virginia. The five sites, described below, were located within the Quantico Creek watershed.

Floodplain – This site was located on a riparian floodplain on the south side of the North Fork of Quantico Creek. The soils were moist to wet during most of the survey period. Tulip tree (*Liriodendron tulipifera*) and river birch (*Betula nigra*) were the dominant canopy trees. Less abundant canopy trees included sycamore (*Platanus occidentalis*) and red maple (*Acer rubrum*). Subcanopy trees were American hornbeam (*Carpinus carolinensis*) and paw-paw (*Asimina triloba*). This site was the only location with herbaceous ground cover (e.g., spring beauty [*Claytonia virginica*], slender toothwort [*Cardamine augustata*], and southern lady-fern [*Athyrium asplenoides*]).

Mesic – American beech (*Fagus grandifolia*) dominated the canopy at this site and produced much of the leaf litter on the deep moist soils. Other canopy trees included white oak (*Quercus alba*) and tulip tree. Red maple, flowering dogwood (*Cornus florida*), and holly (*Ilex opaca*) characterized the understory. The herbaceous layer was sparse with Christmas fern (*Polystichum acrostichoides*) and running cedar (*Diphasiastrum digitatum*). A small intermittent tributary of the North Fork of Quantico Creek was adjacent to this site.

Mixed Hardwood and Pine – This site was on a ridge and in a late stage of ecological succession with mature hardwoods replacing the aging and dying Virginia pine (*Pinus virginiana*). Pines and hardwoods occurred in roughly equal numbers. Dominant hardwoods were southern red oak (*Quercus falcata*), blackjack oak (*Q. marilandica*), and chestnut oak (*Q. montana*). The understory consisted of saplings of these hardwood species. The forest floor was a mix of hardwood leaves and pine needles, and much woody debris. The soil was dry during the majority of the sampling period except during heavy rains.

Mixed Oak - The dominant trees at this site were white oak, American beech, hickory (*Carya* sp.), and red maple with flowering dogwood and American holly in the understory. The relatively dry forest floor was a mix of hardwood leaves and patches of running cedar and ground pine (*Dendrolycopodium obscurum*). The site was located on a gentle slope above a small, unnamed intermittent stream. The soil remained dry during most of the study.

Pine – This highly xeric habitat was located on a flattened ridge area well away from water sources. Virginia pine dominated numerically, with understory trees southern red oak, blackjack oak, white oak, and American beech. The forest floor was covered by pine needles, with several patches of lichen (*Cladonia* sp.). The soil was dry during this study and often hard packed. This site may be an early stage of the mixed hardwood-pine stage, but the soils here were very dry and succession would have to occur over a long period of time.

Methods

We used the drift fence/pitfall technique to capture amphibians, reptiles, and small mammals (Campbell & Christman, 1982; Mitchell et al., 1997). Four arms of aluminum flashing (0.61 m x 7.5 m) were installed upright in a cross configuration with each arm of the array separated from the center of the array by about 7.5 m of open space. At the midpoint of each arm we buried one 19 L (5 gallon) plastic bucket and at both ends of each arm we buried two 3.8 L (#10) cans, one on each side (four total). Thus, each drift fence/pitfall trap array contained 20 pitfalls, each of which had a solution of water and 10-25% dilute formaldehyde to prevent specimens from decomposing, being scavenged by raccoons, and consumed by animals such as shrews (*Blarina*, *Sorex*), and to preserve the vertebrates for additional studies. One array was installed at each of the five sites. Traps were checked every 3-4 weeks from 28 January 1988 to 7 July 1989 for a total of 24 sampling periods. Trap day totals were calculated as the number of days traps were operational multiplied by the number of pitfall traps. We follow Mitchell et al. (1997) in counting the two 3.8 L cans at each end of each fence as one pitfall trap. Thus, the total number of pitfalls per array was four 19 L buckets and eight pairs of 3.8 L cans (12 "pitfalls" per site). Number of trap days per site was 6,312 (31,560 total).

We used Chi-square tests to determine if the number of captures differed significantly among sites (Zar, 1999). We used number of captures because trapping effort was equal for all sites. Herpetofaunal names follow Crother (2012), small mammal names follow Bradley et al. (2014), and plant names follow Weakley et al. (2012).

RESULTS

A total of 895 individuals representing 14 amphibian species (7 anurans, 7 salamanders) was captured during this study (Table 1). The number of species was highest in the floodplain (14) and mixed sites (10), whereas eight species were captured in the mesic and oak sites. The fewest species (7) were recorded on the pine site. Juveniles of four species of *Lithobates* (*L. catesbeianus, L. clamitans, L. palustris, L. sylvaticus*) comprised most of the anuran captures. The latter three were significantly more abundant in the floodplain and mesic sites than the other three sites (Table 1). The toads (*Anaxyrus americanus*) were mostly adults and more numerous on the floodplain, mesic, and mixed sites than in the two xeric sites (Table 1). The pine site had the fewest species and the lowest number of individuals.

All seven salamander species captured in this study were present at the floodplain site (Table 1); the other sites had only 1-3 species each. Numbers of salamanders were higher in floodplain and mesic sites than in the three drier sites (Table 1). The two wetter sites supported significantly higher numbers of salamanders than the three drier sites. The fewest species and the lowest number of individuals occurred at the pine site. Except for two captures on the oak site, most *Ambystoma maculatum* were detected only in the floodplain. Numbers of *Plethodon cinereus* captures were highest on the mesic site (168) and lowest on the pine site (8).

We captured 31 lizards comprising three species and 18 snakes comprising four species in the five study sites. Except for one species, the small numbers of captures precluded statistical comparisons. Only *Plestiodon fasciatus* was present in all five sites: nine in the mesic site, six in the oak site, and four each in the floodplain, mixed, and pine sites. Number of captures among sites were not significantly different (χ^2 = 3.556, P = 0.4695). We captured one *Plestiodon laticeps* on the floodplain and two on the pine sites, and one *Sceloporus undulatus* in mixed and oak sites. A single individual of two species of snakes was captured in the study sites: *Coluber constrictor* (oak) and *Thamnophis sirtalis* (mesic). We captured one *Carphophis amoenus* at two sites (floodplain, oak) and one *Diadophis punctatus* at three sites (floodplain, mesic, mixed).

We captured four species each of shrews and rodents in this study (Table 2). Mammal species richness varied from four at the pine site (3 shrews, 1 rodent) to seven in the floodplain (4 shrews, 3 rodents) and mesic sites (3 shrews, 4 rodents). Of the 155 small mammals, 76.8% were shrews and 23.2% were rodents. Shrews were dominated numerically by *Blarina brevicauda* (39.5%) and *Sorex hoyi* (42%). Insectivores were significantly fewer at the pine site. Three species tested statistically did not differ significantly in number of captures among all sites (Table 2). No site yielded many rodents, but *Peromyscus leucopus* was most abundant, especially at the mesic site. The pine site yielded only one *P. leucopus*. The one *Condylura cristata* was caught in the floodplain forest.

DISCUSSION

The number of amphibian species captured by the drift fence/pitfall technique was about half of those expected for northern Virginia. The seven species of frogs represented 50% of expected and the seven species of salamanders represented 64% of expected (Mitchell & Reay, 1999). The majority of anurans captured were metamorphs and juveniles and the majority of salamanders were adults. This pattern is similar to captures obtained during a drift fence/pitfall study in old field and mixed hardwoods in central Virginia (Mitchell, 2014). Fifty-seven percent of the expected species of shrews and moles and 40% of the expected mice and chipmunks were captured with this technique in the five habitats studied (Linzey, 1998). Small mammal species obtained in central Virginia were the same as those captured by Pagels et al. (1992) and the upper Coastal Plain by Bellows & Mitchell (1999, 2000).

Table 1. Species richness and relative abundance of amphibians in five forested habitats in northern Virginia. Raw numbers are provided and analyzed because capture effort was the same for all habitats. FP = floodplain, Mes = mesic, Mix = mixed. NT = not tested due to small sample size.

Species	Common Name	FP	Mes	Mix	Oak	Pine	Total	χ^2	P
Anurans									
Acris crepitans	Northern Cricket Frog	3	3	3	0	1	10	4.00	0.4060
Anaxyrus americanus	American Toad	24	31	22	5	8	90	27.22	<0.0001
Pseudacris crucifer	Spring Peeper	6	0	2	4	1	13	8.92	0.0631
Lithobates catesbeianus	American Bullfrog	36	1	2	1	0	40	122.75	<0.0001
Lithobates clamitans	Green Frog	73	41	21	5	1	141	124.14	<0.0001
Lithobates palustris	Pickerel Frog	76	39	9	4	3	131	151.56	<0.0001
Lithobates sylvaticus	Wood Frog	22	12	1	3	1	39	42.92	<0.0001
No. Species		7	6	7	6	6	7		
Subtotal		240	127	60	23	15	465	374.60	<0.0001
No./trap day x 100		4.83	2.56	1.21	0.46	0.31			
Salamanders									
Ambystoma maculatum	Spotted Salamander	21	0	0	2	0	23	15.96	<0.0001
Ambystoma opacum	Marbled Salamander	2	1	0	0	0	3	NT	
Eurycea bislineata	Northern Two-lined Salamander	5	0	0	0	0	5	NT	
Eurycea guttolineata	Three-lined Salamander	15	0	0	0	0	15	NT	
Hemidactylium scutatum	Four-toed Salamander	2	0	1	0	0	3	NT	
Plethodon cinereus	Red-backed Salamander	77	168	77	49	8	379	182.31	<0.0001
Plethodon cylindraceus	White-spotted Slimy Salamander	1	0	1	0	0	2		
No. Species		7	2	3	2	1	7		
Subtotal		123	169	79	51	8	430	181.58	<0.0001
No./trap day x 100		2.47	3.40	1.59	1.02	0.16			
Total		363	296	139	74	23	895	472.10	<0.0001
Number of species		14	8	10	8	7	14		

Table 2. Species richness and relative abundance of small mammals in five forested habitats in northern Virginia. Raw numbers are provided and analyzed because capture effort was the same for all habitats. FP = floodplain, Mes = mesic, Mix = mixed. NT = not tested due to small sample size.

Species	Common Name	FP	Mes	Mix	Oak	Pine	Total	χ^2	P
Insectivores									
Blarina brevicauda	Northern Short-tailed Shrew	9	10	10	13	5	47	3.53	0.473
Condylura cristata	Star-nosed Mole	1	0	0	0	0	1	NT	
Sorex hoyi	American Pygmy Shrew	9	10	11	16	4	50	7.40	0.116
Sorex longirostris	Southeastern Shrew	4	4	8	3	2	21	4.95	0.292
No. Species			4	3	3	3	3	4	NT
Subtotal		23	24	29	32	11	119	10.87	0.028
#/trap day x 100		0.46	0.48	0.58	0.64	0.22			
Rodents									
Microtus pennsylvanicus	Meadow Vole	2	1	3	2	0	8	3.25	0.517
Peromyscus leucopus	White-footed Mouse	3	3	13	1	2	22	21.64	0.0002
Tamias striatus	Eastern Chipmunk	0	1	0	0	0	1	NT	
Zapus hudsonius	Meadow Jumping Mouse	3	2	0	0	0	5	NT	
No. Species		3	4	2	2	1	4		
Subtotal		8	7	16	3	2	36	17.06	0.0019
#/trap day x 100		0.16	0.14	0.32	0.06	0.04			
Total		31	31	45	35	13	155	17.29	0.0017
Number of species		7	7	5	5	4	8		

Land-use history plays an important, if not dominant, role in the compositional variation of forests and species use of regrowth forest in northern Virginia. The 7,000 ha PWFP, established in 1937 as a recreational area, is an example of the potential for regrowth of forests to maintain and enhance the recovery of native fauna. Its history includes a succession of Native American inhabitants, charcoal production for iron, land clearing during the Civil War, various types of agriculture and pasture, and finally land reclamation by the Civilian Conservation Corps in the early 1930s (Orwig & Abrams, 1994; Potomac Appalachian Trail Club, 2015). Natural succession and reforestation since the 1930s have created a mosaic of habitats, much of it in forest cover, allowing us to select a range of habitat types for study.

Contrasting habitats of forest (mesic) versus non-forest (xeric) allowed us to gain insight into the composition and habitat distribution of these vertebrate assemblages before the land was cleared historically for agriculture and timber. Several studies conducted in Virginia have demonstrated that old fields are used extensively by insectivores and rodents, but not amphibians and some reptiles. Studies at forested and old field sites in central Virginia are an example of this contrast (Pagels et al., 1992; Mitchell, 2014). Small mammal species richness and abundance is higher in old fields than in hardwood forests on Fort A.P. Hill in Caroline County (Bellows et al., 1999, 2001) and higher in logged forests than unlogged forests in the southwestern Virginia Piedmont (Shively et al., 2006). In contrast, amphibian species richness and abundance is higher in forested habitats than logged or old field habitats in central Virginia (Mitchell, 2014), the southwestern Piedmont (Fredericksen et al., 2006; Burress et al., 2011), mountains in western Virginia (Mitchell et al., 1997), and southeastern Virginia (Buhlmann et al., 1994).

The primary environmental feature that influences alpha diversity and population sizes of amphibians in Prince William Forest Park forests is soil moisture. More species and individuals were captured in moist sites than in drier sites, an expected result because of amphibian moisture requirements (Duellman & Trueb, 1986). Reduced soil moisture is correlated to higher environmental temperatures that together create conditions unsuitable for most amphibians. The differences we observed in species richness and relative abundance among these habitats is generally consistent with results of numerous other studies. Salamander abundance was significantly higher in wetter old growth forests than in drier recent clear-cuts in Missouri (Herbeck & Larsen, 1999), New Brunswick (Waldick et al., 1999), and Vancouver Island in Canada (Dupuis et al., 1995). More amphibians were found in hardwood forests than in cutover, pine, and recently burned sites in Delmarva (McLeod & Gates, 1998), on recent clear-cut sites in Craig and Montgomery counties in Virginia (Bylmer & McGinnes, 1977), and in mixed pine-hardwood sites in Arkansas (Loehle et al., 2005). Clear-cut forests and pine stands which usually occur on dry soils are unable to retain enough soil moisture to meet the moisture requirements of most amphibians.

Composition of reptile assemblages in forest habitats was as variable as the composition of trees, subcanopy, and herbaceous vegetation. Few reptiles were captured with the drift fence/pitfall trap arrays used in this study because small pitfalls are not effective in capturing most reptiles. We did not use funnel traps, a standard technique for capturing terrestrial reptiles, especially snakes (Fitzgerald, 2012), because we were unable to be present at the site every day. Even though the number of captures was small, the pattern of captures for lizards versus snakes followed results of other studies. Numerically, we found more lizards on the drier mixed and pine sites than in the floodplain and mesic sites. More snakes were found on floodplain and mesic sites compared to the three drier sites. These results differ from that found by Clawson et al. (1984) in Missouri. In their study using pitfalls and funnel traps, *Plestiodon fasciatus* and *P. laticeps* occurred in greater abundance in upland forest (mesic) than in old-field (xeric) sites and more *Coluber constrictor* and *Diadophis punctatus* occurred in old-fields than in upland forests. Our results are similar to those of Mitchell (2014), who captured more lizards in old-fields than in hardwood forests in central Virginia. Snake species richness was similar in old-fields and hardwoods but more individuals were captured in the latter habitat type. However, the small sample sizes preclude definitive generalizations. More reptiles (lizards and snakes combined) occur on harvested, open canopy, and clearcut sites than on unharvested hardwoods with full canopy (Adams et al., 1996; McLeod & Gates, 1998), primarily due to their need for sunlight to aid in thermoregulation.

Small mammal species found primarily in grass-dominated habitats (e.g., *Cryptotis parva*, *Reithrodontomys humulis* (Bellows et al., 2001) were not present in our study. All three species of insectivores and rodents captured by McLeod & Gates (1998) in Maryland occurred in hardwood, clear-cut, pine, and burned sites. Ground cover was much higher in their pine and burned sites, but number of captures did not differ substantially from those in the hardwoods and clear-cuts. Kirkland et al. (1996) found significantly more shrews and rodents in an unburned than in a burned hardwood forest in Pennsylvania.

Except for *Peromyscus leucopus* which occurred in both habitat types, more small mammals were captured in logged than unlogged hardwood forests in Franklin County, Virginia (Shively et al., 2006). *Peromyscus leucopus* is a habitat generalist that can tolerate variable environmental conditions (Linzey, 1998). More individuals of both groups occurred in old-fields than hardwood forests in the central Virginia Piedmont (Pagels et al., 1992) and on Fort A.P. Hill in the upper Coastal Plain (Bellows & Mitchell, 1999). Their old-fields had more abundant herbaceous cover and woody debris than the unlogged sites, features favorable to most small mammals (Kirkland et al., 1985).

The mixed hardwood and pine forest now characterizing Prince William Forest Park and much of northern Virginia resulted from ecological succession of former farmland largely devoid of forest cover throughout the 1800s into the 1920s. The land in this area was extensively farmed and logged and likely only patches of secondary forest were standing when the park was created in 1937 (Potomac Appalachian Trail Club, 2015). Reforestation to native forests usually results in recovery of herpetofaunal assemblages. For example, reforestation of former agricultural sites resulted in a 68% recovery of the native reptile fauna in the limestone region of Puerto Rico (Ruiz-Jaen & Aide, 2005). The range of variation in forest and herbaceous cover, moisture, and temperature in the restored sites in PWFP likely has accounted for the variation in the response of amphibians, reptiles, and small mammals to the changing conditions.

The management approach of the National Park Service to interfere as little as possible with forest regrowth has resulted in a mosaic of forest cover types that are used in different ways by amphibians, reptiles, and small mammals. The age and composition of these forest types have been influenced by geographic variation in soil moisture and site history, but they were generally allowed to develop naturally with little to no management. The forest in PWFP derived from restoration and natural regrowth should allow long-term persistence of the herpetofauna and small mammals characteristic of this region. Quantico Marine Corps Base, which abuts the park on the south side, is also largely forested, thus making these two areas a habitat island within the expansive urban development surrounding it.

ACKNOWLEDGMENTS

We thank Riley Hoggard, formerly of Prince William Forest Park, for his financial support for this project through the Virginia Department of Conservation and Recreation's Division of Natural Heritage. David A. Young assisted extensively in the field and collected many of the pitfall samples. The edits by the editor and two reviewers improved the quality of this paper.

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Banisteria, Number 46, pages 12-24
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A Survey of Amphibians at the Smithsonian Environmental Research Center, Anne Arundel County, Maryland

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ABSTRACT

During a two-year amphibian inventory at the Smithsonian Environmental Research Center (SERC) in Anne Arundel County, Maryland, we documented approximately 93% (13/14) of the county's frog and toad fauna and 56% (5/9) of the salamanders. We also provide a general framework for monitoring difficult-to-detect calling anurans (Wood Frog and Eastern Spadefoot) and Spotted Salamander at SERC. In addition, we incidentally documented 53% (21/40) of the county's reptiles. The known herpetofauna of SERC consists of 39 species.

Key words: amphibian, anuran call surveys, amphibian monitoring, frogs, toads, salamanders.

INTRODUCTION

Amphibians are part of a global biodiversity crisis (Blaustein et al., 1994). One third of amphibian species are threatened with extinction, and nine species have gone extinct since 1980 (IUCN, 2015). Reasons for population declines and extinction include natural population fluctuations and a complex of anthropogenic factors, including habitat loss, pollution, climate change and chytridiomycosis, a disease of the skin caused by a pathogenic fungus *Batrachochytrium dendrobatidis* (Davidson et al., 2003; Young et al., 2007; IUCN, 2015). Amphibians are particularly susceptible to habitat destruction and chytridiomycosis in part because they have relatively thin, permeable skin that serves as a respiratory organ and (most typically) a biphasic life history that includes a gilled aquatic larval phase and a terrestrial adult form (Blaustein & Wake, 1995; Vitt & Caldwell, 2013). Consequently, amphibians are among the most sensitive vertebrates to various forms of environmental disturbances, and are considered to be indicators of environmental health (Wyman, 1990). Depending on the species, one sexually mature female may produce hundreds or thousands of embryos, potentially contributing substantial amounts of biomass (in the form of larvae and newly metamorphosed subadults) to their resident ecosystems annually (Wright & Wright, 1949; Vitt & Caldwell, 2013). Thus, amphibians are critical trophic links between aquatic and freshwater ecosystems, and local extinctions can in turn lead to ecological imbalances (Whiles et al., 2006). Due to their ecological importance, environmental sensitivity, and documented declines, localized and large-scale inventory and long-term amphibian monitoring programs have been implemented throughout North America (Weir & Mossman, 2005; Weir et al., 2009; see Cook et al., 2011).

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The Smithsonian Environmental Research Center (SERC) in eastern Maryland serves as a natural laboratory for long-term ecological research. The Center seeks to understand the impacts of climate change, invasive species, anthropogenic land use, pollution, and fishery harvest on native flora and fauna (SERC, 2015a). However, aside from selected herbivore-plant interactions, relatively little is known of the non-estuarine fauna of SERC (but see Heyer 1976, 1979; Lynch, 1984; Szlavecz et al., 2011; Cook-Patton et al., 2014a, b). We report the results of an amphibian inventory and provide baseline data that can be used to establish a long-term amphibian monitoring program at SERC.

MATERIALS AND METHODS

Study Area and Site Selection

SERC (38°33'17.57"N; 76°33'14.29"W) consists of approximately 1,477 ha of hardwood-dominated forest, ponds, creeks, rivers, tidal marshes, and 19.3 km of protected shoreline along the Rhode River and upper Chesapeake Bay in Anne Arundel County, Maryland (SERC, 2015b; Fig. 1). Forests at SERC can be broadly classified into three main types: (1) the majority (~85%) is a Tulip-poplar (*Liriodendron tulipifera*) association; (2) a moist lowland assemblage, comprised of American sycamore (*Platanus occidentalis*), ash (*Fraxinus* spp.), elms (*Ulmus* spp.), river birch (*Betula nigra*), and other woody vegetation along freshwater streams; and (3) a somewhat xeric assemblage that fringes tidal marshes, consisting of chestnut oak (*Quercus prinus*), white oak (*Quercus alba*), black gum (*Nyssa sylatica*), mountain laurel (*Kalmia latifolia*), blueberries (*Vaccinium* spp.) and other woody vegetation. Like much of the eastern U.S., SERC's forest age and structure reflect historical agricultural activities and local history. The land that now comprises SERC's main campus was mostly fallow from the end of the Civil War to approximately 1915, when it was used as a dairy with grazing pastures and fields for feed production until 1945. Thus, the majority of SERC's contemporary forests are ca. 70-150 years old (Higman, 1968; McMahon et al., 2010, G. Parker, SERC pers. comm.).

Freshwater inputs into the Rhode River are primarily from the North Fork Muddy Creek, South Fork Muddy Creek, and their lower order streams. These streams are associated with several swamps, beaver impoundments, and vernal wetlands which range from small, tannin-rich, short-hydroperiod ephemeral wetlands, to larger and clearer-water permanent ponds. We selected 15 (Fig. 1) of these wetlands to sample. Site selection was not random, and was based in part on accessibility.

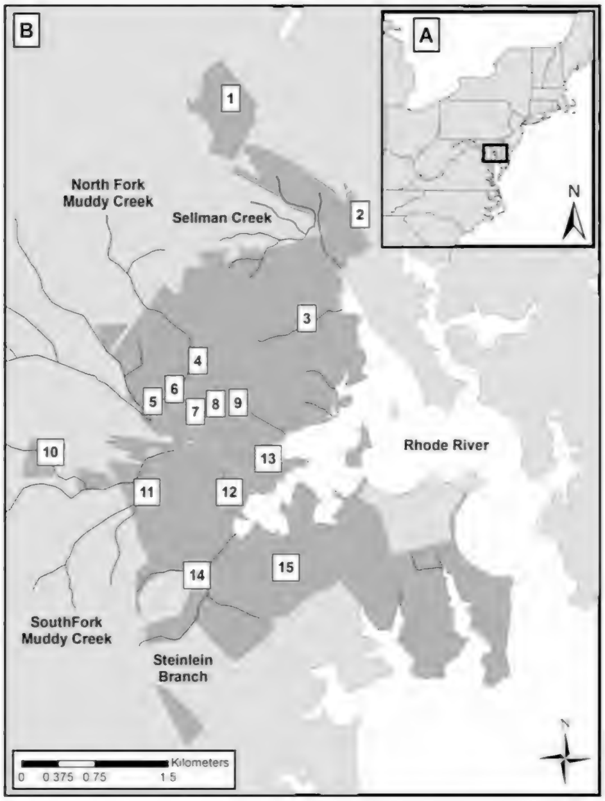

Fig. 1. Map of anuran calling survey sites, 2014-2015. Dark shaded areas represent SERC with numbers indicating locations of surveys sites: (1) Glebe Bog, (2) Camp Letts Pond, (3) Contees Wetland/Cypress Swamp, (4) Beaver Pond, (5) North Fork (6) Snake House Wetland, (7) Construction Pond, (8) Mathias Wetland, (9) Retaining Pond, (10) Mill Swamp, (11) O'Neill Marsh (12) Hog Island Complex, (13) Fox Point, (14) Horseshoe Bog, and (15) CO2 Marsh.

Anuran Call Surveys

We conducted weekly anuran (frog and toad) call surveys between 21 March and 5 September 2014 and 2015 following North American Amphibian Monitoring Program guidelines (Weir & Mossman, 2005). Sampling began after sunset and consisted of listening for calling anurans for 5 min at each site. Most surveys began well after sunset, but before 0100 h ($\bar{x}$ = 116.4 min after sunset; SE = 4.69). Each detected species was assigned an ordinal calling index value (scale of 1-3) based on the degree of overlap between calls (Weir & Mossman, 2005). Undetected species were assigned a rank of "0" for that survey. During each call survey, we also recorded surface water and air temperatures with fixed armor casting pocket thermometers, and sky and wind conditions, and noise interference levels based on protocols in Weir & Mossman (2005). We stopped conducting anuran call surveys at sites if surveys resulted in non-detections for all species for four consecutive weeks.

Egg Mass Counts

Wood Frogs (*Lithobates sylvaticus*) often vocalize diurnally and oviposit globular and conspicuous egg masses in permanent and ephemeral wetlands (Wright & Wright, 1949; Berven 1990; Klemens, 1993). Thus, egg mass counts are a widely used technique to monitor their populations (Berven, 1990; Crouch & Paton, 2000; Cook & Boland, 2005). Spotted Salamander (*Ambystoma maculatum*) oviposits similarly (Wright & Allen, 1909), and egg mass counts are also used to monitor their populations (Brodman, 1995, 2005; Egan & Paton, 2004; Petranka et al., 2003; Cook & Boland, 2005). We conducted three rounds of egg mass counts via the maximum daily count method (Cook & Boland, 2005) at seven wetlands during known breeding periods after the onset of appropriate temperatures (Crouch & Paton, 2000; Egan & Paton, 2004; Brown & Jung, 2005). To maximize visibility, we only conducted counts while wearing polarized glasses during relatively clear, calm weather.

Additional Sampling Methods

Due to the explosive breeding behavior of the Eastern Spadefoot (*Scaphiopus holbrookii*) (Hansen, 1958), there is a greater chance of not detecting this species with call surveys (Cook et al., 2011). Therefore, we augmented call surveys by using throw trapping (quantitative enclosure sampling), [see Shaffer et al., 1994] combined with a removal sampling [Hayek, 1994]) as means of detecting and quantifying Eastern Spadefoot tadpole abundance. The throw trap was a 1 m^3 box with fine mesh screening attached on four sides. The top and bottom of the trap remained unscreened. Before sampling we created cross-sectional and longitudinal transects in the wetland which we used to guide tossing of the trap. Every two meters along each transect we tossed the trap into the water (open sides down and up). Using an aquatic D-frame dip net, we scooped out larvae, counted them, and temporarily removed them from the wetland in five-gallon buckets until we made it completely across both transects.

We used time-constrained searches (Scott & Woodward, 1994) to identify salamanders and anurans that were undetected with egg mass counts and anuran call surveys. We began each search at an anuran call survey site and walked away from the starting point haphazardly looking for herpetofauna, both outwardly visible and beneath debris, for 45 minutes. If detected during time-constrained searches, or otherwise incidentally while traveling between sites, we considered a given species "present." We documented species at sites other than at habitats adjacent to call survey sites, so those sites also appear in Table 1.

We calculated descriptive statistics with Minitab version 16 and Microsoft Excel 2013. Maps were created in ArcGIS 10.1. We based common names, and generic and specific epithets of herpetofauna on Crother (2012).

RESULTS

Anuran Call Surveys

We conducted a total of 503 anuran call surveys at 15 sites between 13 March and 5 September 2014 and 2015, documenting 13 species. The Construction Pond, Mathias Wetland, Retaining Pond, Beaver Pond, and Horseshoe Bog contained the most species. By contrast, only one species was detected at Fox Point, which also had the fewest detections of calls. Surveys conducted at the Mathias Wetland and Mill Swamp yielded the highest proportions of detections (Tables 1 and 2). Onset of calling occurred earliest in Spring Peeper (*Pseudacris crucifer*) and Wood Frog (on our first survey; 72nd and 73rd day of the year), and latest in Green Treefrog (*Hyla cinerea*; 114th day of the year). We detected full choruses (calling index values = 3) in all species except Upland Chorus Frog (*Pseudacris feriarum*) and Gray Treefrog (*Hyla versicolor*). We only detected Eastern Spadefoot while in full chorus, and only in 2014 (Table 3).

Egg Mass Counts, Throw Trapping, Time Constrained Searches, and Incidental Encounters

Between 24 March and 18 April 2015, we conducted egg mass counts at seven sites, yielding maximum counts of 977 Wood Frog and 209 Spotted Salamander egg masses. The Beaver Pond (a large permanent wetland) had the most Spotted Salamander egg masses (31% of the total), and Snake House Pond (a relatively small, short hydroperiod wetland) contained the fewest (0.01%). Over half of Wood Frog egg masses (54.2%) were located at Horseshoe Bog (a large river-fed seasonal wetland), whereas only one egg mass was found at Snake House Pond (Table 4).

We captured 3,826 Eastern Spadefoot tadpoles at the only known breeding site (Camp Letts Pond) with one round of 11 throws of a single trap in 2014. We did

Table 1. Detections of amphibians and reptiles at SERC study sites. An “x” = detected, a dash = not detected. Site abbreviations not identified in Appendix 1 are: EDU (Education Building), located ~0.75 km NNE of Fox Point. See Appendix 2 for species abbreviations.

Species	BEPO	CALE	CO2	COPO	CONTE	EDU	GLEBE	FOPO	HOMA	HOVE	HOSH	MATH	MISW	NOFR	ONEIL	RETAIN	SNHO
AMTO	X	-	X	X	-	X	X	-	X	X	X	X	X	X	X	-	X
BOTU	X	-	-	X	-	X	-	-	-	-	-	-	-	-	X	-	-
BUFR	X	-	-	X	X	-	X	-	-	-	-	X	X	-	-	X	X
CGTF	X	X	-	X	X	X	X	-	X	-	X	X	X	-	X	X	-
CHFR	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-
CRFR	X	-	-	X	X	-	-	-	-	-	X	X	X	X	X	X	X
DBTE	-	-	X	-	-	X	-	X	X	-	-	-	-	-	-	-	-
FLSK	X	-	X	X	-	X	-	-	X	-	-	X	-	-	X	X	-
FTSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
GASN	X	-	-	X	X	-	-	-	-	-	-	-	-	-	-	X	X
GRFR	X	X	X	X	X	-	X	-	-	X	X	X	X	X	X	X	X
GRTF	X	-	-	X	X	-	-	-	X	-	-	X	X	-	-	-	X
KISN	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
MASA	X	-	-	X	X	-	-	-	-	-	X	-	-	-	X	-	-
MUDT	X	-	-	-	X	X	-	-	-	-	-	-	-	-	-	X	-
MUSK	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NBSN	X	-	-	X	-	-	-	X	-	-	-	X	-	-	-	X	-
NGTF	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-
NWSN	X	-	-	X	-	X	X	X	X	-	-	-	-	-	-	X	X
PATU	X	-	X	X	-	-	-	X	X	-	-	-	X	-	-	X	-
PIFR	X	-	X	X	X	-	X	-	X	-	X	-	X	-	X	X	X
RACER	X	-	-	X	-	X	-	-	X	-	-	-	-	-	X	X	-
RASN	X	-	-	X	-	X	X	-	-	-	-	-	-	-	-	X	X
RBSA	X	X	-	-	X	-	X	-	X	-	X	-	-	-	-	-	X
RBTU	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-
RESL	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-
RGSN	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
RISN	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X
RNSN	X	X	-	X	X	-	-	-	X	-	-	-	-	-	-	-	-
RSNE	X	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
SESN	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
SLFR	X	X	X	X	X	X	X	X	X	-	X	X	X	-	X	X	X
SNTU	X	-	X	X	-	X	-	X	X	-	-	-	X	-	-	X	-
SPPE	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X
SPSA	X	-	-	-	X	-	X	-	-	-	X	-	-	-	-	-	X
SPTO	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPTU	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	X
WOFR	-	X	-	X	X	-	X	-	-	-	X	X	-	-	X	-	-
WOSN	X	-	X	X	X	-	-	-	-	-	-	-	-	-	X	-	-

Table 2. Proportion of surveys yielding detections per study site at SERC. * = Documented after study period. See Appendix 2 for species abbreviations.

Site	AMTO	BUFR	CHFR	CGTF	CRFR	GRFR	GRTF	PIFR	SLFR	SPPE	SPTO	WOFR
Beaver Pond	0.04	0.68	-	0.08	0.48	0.72	0.20	0.20	0.24	0.32	-	*
Camp Letts Pond	-	-	-	0.21	-	0.21	-	-	0.21	0.50	0.14	0.07
CO2 Marsh	0.30	-	0.30	-	-	0.10	-	0.10	0.50	0.60	-	0.00
Construction Pond	0.16	0.36	-	0.32	0.36	0.64	0.20	0.12	0.36	0.28	-	0.08
Contees Wetland	-	-	-	0.13	-	0.20	-	0.07	-	0.40	-	-
Cypress Swamp	-	-	-	-	-	-	-	-	-	-	-	-
Glebe Bog	-	-	-	-	-	0.47	-	-	0.05	0.37	-	0.05
Fox Point	-	-	-	-	-	-	-	-	0.09	0.00	-	-
Hog Main	0.18	-	-	0.18	-	-	-	-	0.55	0.36	-	-
Hog Vernal	-	-	-	-	-	-	-	-	-	-	-	-
Horseshoe Bog	0.09	0.04	-	0.48	0.30	0.61	-	0.09	0.26	0.30	-	0.04
Mill Swamp	0.08	0.63	-	0.29	0.63	0.79	0.25	0.25	0.25	0.29	-	-
North Fork	-	-	-	-	-	-	-	-	0.25	0.38	-	-
O'Neill Marsh	0.15	-	-	0.25	-	0.60	-	0.25	0.30	0.35	-	0.05
Retaining Pond	-	0.67	-	0.21	0.46	0.67	-	0.08	0.04	0.29	-	-
Snake House Wetland	-	-	-	-	0.08	0.08	-	-	-	0.08	-	-

Table 3. Seasonal calling chronology of anuran species detected on CAS at SERC. Data are pooled from 2014 and 2015. Values are maximum calling index values calculated for each species during a given sampling period. See Appendix 2 for species abbreviations.

Sampling Period	AMTO	BUFR	CGTF	CHFR	CRFR	GRFR	GRTF	NGTF	PIFR	SLFR	SPPE	SPTO	WOFR
March 13-March 19	-	-	-	-	-	-	-	-	-	1	3	-	3
March 20-March 27	3	-	-	-	-	-	-	-	1	3	3	-	3
March 28-April 3	3	-	-	2	-	-	-	-	1	2	3	-	-
April 4-April 10	3	1	-	2	-	-	-	1	3	2	3	-	-
April 11-April-17	1	2	-	-	1	1	-	-	2	1	3	-	-
April 18-April25	1	2	3	-	-	1	-	1	-	2	3	3	-
April 26-May2	1	2	3	-	3	2	-	-	2	2	3	-	-
May 3-May 9	-	3	3	-	3	3	-	-	-	1	-	-	-
May 10-May 16	-	1	-	-	3	1	-	-	-	1	-	-	-
May 17-May 23	-	2	3	-	3	3	2	-	-	1	-	-	-
May 24-May 30	-	3	2	-	3	3	1	1	-	-	-	-	-
May 31-June 6	-	1	3	-	3	3	1	-	-	-	-	3	-
June 7-June 13	-	2	2	-	3	3	2	-	-	-	-	-	-
June 14-June20	-	2	2	-	3	3	2	-	-	-	-	-	-
June 21-June 27	-	1	2	-	3	3	1	-	-	-	-	-	-
June 28-July 4	-	1	1	-	3	3	3	-	-	-	-	-	-
July 5-July 11	-	1	1	-	3	3	1	-	-	-	-	-	-
July 12-July 18	-	1	1	-	2	3	2	-	-	-	-	-	-
July 19-July 25	-	1	-	-	-	1	-	-	-	-	-	-	-
July 26-Aug 1	-	1	-	-	-	1	-	-	-	-	-	-	-
Aug 2-Aug 8	-	1	1	-	1	3	-	-	-	1	-	-	-
Aug 9-Aug 15	-	1	-	-	-	1	-	-	-	-	-	-	-
Aug 16-Aug 22	-	1	-	-	-	1	-	-	-	-	-	-	-
Aug 23-Aug 29	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug 30-Sep 5	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4. Number of egg masses detected, grouped by species and site.

Site	SPSA	WOFR
Beaver Pond	65	2
Camp Letts Pond	26	87
CO2 Marsh	19	12
Contees Wetland	49	114
Horseshoe Bog	11	530
O'Neill Marsh	36	231
Snake House Wetland	3	1

not complete a second round of throws because the wetland dried just prior to sampling. The largest concentration of tadpoles appeared to be in the shallower regions toward the edge of the wetland. We did not find Eastern Spadefoot tadpoles or adults in 2015.

A total of 1,170 search minutes (19.5 hours) in 2014 and 2015 yielded three additional salamander species: Eastern Newt (*Notophthalmus viridescens*; 3 sites), Eastern Red-backed Salamander (*Plethodon cinereus*; 6 sites) and Marbled Salamander (*Ambystoma opacum*; 4 sites). Spotted Salamander was detected at five additional sites and one Four-toed Salamander (*Hemidactylium scutatum*) was found incidentally at a sphagnum-rich bog ca. 200 m northeast of O'Neill Wetland. All salamander species except the latter can be found at the Beaver Pond. Contees Wetland and Horseshoe Bog (both seasonal wetlands) contained three of these species.

DISCUSSION

Overview

SERC's main campus and additional parcels provide habitat for approximately 93% (13/14) of Anne Arundel County's anurans, and 56% (5/9) of its salamanders. We also incidentally documented approximately 53% (21/40) of the county's reptiles (Reed, 1956; MARA, 2015; Table 1). These numbers include sea turtles and historical records, but exclude documented non-natives. In total, 39 species were found, 28 of which can be found in or near the Beaver Pond. Although all species documented at SERC in this study can be found elsewhere in Anne Arundel County, Upland Chorus Frog, Eastern Spadefoot, and Four-toed Salamander are uncommon in the county. Upland Chorus Frog is under consideration for possible state listing (MARA, 2015). We heard choruses of this species at two adjacent, vernal sites (Horseshoe Bog and CO2 Marsh) along the south side of Rhode River (Fig. 1). Although this population appears to be small, we recommend continued monitoring and searches for additional Upland Chorus Frog breeding areas at SERC. The only breeding site (Camp Letts Pond) used by the Eastern Spadefoot identified in this study contains water for short periods after major rain events, and is the closest study site to sandier areas associated with Chesapeake Bay shorelines. The lone Four-toed Salamander documented in this study was found inside a rotting log in a boggy area close to the O'Neill Wetland. This species occurs in and around boggy ponds and floodplains, is almost always associated with sphagnum moss, and is patchily distributed even in areas with suitable habitat (Klemens, 1993). We recommend further targeted sampling of likely habitats to fully access the occurrence of Four-toed Salamander at SERC.

Although not documented in this study, Northern Two-lined Salamander (*Eurycea bislineata*), Northern Dusky Salamander (*Desmognathus fuscus*), and Mud Salamander (*Pseudotriton montanus*) were purportedly detected at SERC in the early 1980s (J. Lynch, SERC, unpubl. data). Additionally, the Maryland Biological Stream Survey documented Northern Two-lined Salamander (1997, 2008, and 2014) and *Pseudotriton* sp. (2008) in tributaries of the North Fork Muddy Creek, immediately adjacent to SERC (MBSS, 2015). Preferred habitats of these species vary, but in general, they inhabit streams of varying gradients containing partially submerged cover and nearby damp, closed-canopy woodlands and vernal ponds (Bruce, 1975; see Klemens, 1993). We conducted few time-constrained searches in habitats appropriate for these species. Therefore, future sampling along North Fork Muddy Creek (where suitable habitat exists) may provide a more accurate assessment of their presence at SERC.

Fowler's Toad (*Anaxyrus fowleri*) was not detected in our study, but purportedly was found at SERC in the early 1980s (J. Lynch, SERC, unpubl. data). This species is a subclimax community habitat specialist that favors early successional (pine, pine-oak, or scrub) habitats with well-drained, sandy soils and open-canopy (both permanent and ephemeral) wetlands (Klemens, 1993; Tupper & Cook, 2008). These habitats are scarce at SERC. It is possible that natural successional changes since the early 1980s may have made SERC unsuitable for this species. However, it is more likely that subadult American Toads (*Anaxyrus americanus*) were misidentified as Fowler's Toads. Therefore, we consider prior reports of Fowler's Toad unreliable in the absence of additional supporting documentation. Fowler's Toad occurs elsewhere in Anne Arundel County where its preferred habitat is more abundant (MARA, 2015)

Recently, a new species of frog, the Coughing Frog, or Atlantic Coast Leopard Frog (*Lithobates kauffeldi*), was described (Feinberg et al., 2014). Suitable habitats for this species likely occur at SERC, but its status in Maryland is not yet determined (MARA, 2015). Analyses of recordings of Leopard Frogs at SERC were confirmed as being Southern Leopard Frog (*Lithobates sphenocephalus*) by J. Feinberg (Rutgers University, New Brunswick, New Jersey). We are currently using automated data recorders to determine if Coughing Frog exists at SERC.

Anuran Call Surveys

Anuran call surveys are an inexpensive and effective way of detecting anurans and monitoring their long-term population trends (Weir & Mossman, 2005; Weir et al., 2009; Cook et al., 2011). Our work will allow natural resource managers to initiate a citizen science-based approach to anuran monitoring. Citizen science-generated data has been useful in a variety of monitoring programs (Conrad & Hilchey, 2011; Dickenson et al., 2010). Community involvement in amphibian monitoring at SERC is necessary for monitoring to continue because there are currently no funded amphibian monitoring initiatives at SERC. We encourage readers to volunteer.

Patterns in anuran vocalization are similar to other Mid-Atlantic studies (Lee, 1973; Ernst. et al., 1997; Weir et. al., 2005; Tupper et. al 2012). However, a noticeable variation occurred in American Bullfrog. Onset of calling in this species occurred three weeks earlier (a full month earlier if we consider 2016 data; 73rd vs. 112th day of the year) in our study than was recorded at Huntley Meadows Park in Alexandria, Virginia just five years prior (Tupper et al., 2012; see also estimates of American Bullfrog detection probability by Weir et al., 2005). Onset of calling in American Bullfrog from these Mid-Atlantic studies occurred prior to, or immediately after, the earliest records of calling documented in North Carolina in 1933 (Harper, 1935). Given the more southern latitude, we would expect early records of calling in North Carolina to reflect a corresponding earlier breeding phenology. However, the earliest record reported in Harper (1935) is 19 days later than our earliest observation. Furthermore, when we compared the breeding phenologies of 10 anuran species from SERC to the same species documented at Huntley Meadows Park in 2010 and 2011, we found that 90% called earlier at SERC than they did at Huntley Meadows Park. The unexpected differences to Harper (1935) may simply be anecdotal, and the short-term differences between the breeding phenologies of anurans at SERC and Huntley Meadows Park could be due to localized environmental variation. However, the direction and magnitude of these differences (particularly in American Bullfrog) are of interest because they support a growing body of data indicating that climate warming is causing onset of anuran calling to occur earlier than formerly known because minimum thresholds for calling activity also occur earlier (Gibbs & Breisch, 2001; Parmesan & Yohe, 2003; Ledneva et al., 2004; Corn, 2005; Tupper et al., 2012). Although the precise effects of climate change on amphibians are yet to be determined, the majority of speculated consequences are negative (Gibbons et al., 2000; Corn, 2005; Parmesan, 2006). Therefore, continued long-term monitoring of anuran populations could help elucidate phenological changes that may result from climate change.

Due to infrequent, explosive patterns of vocalization, it is difficult to detect Eastern Spadefoot with standardized anuran call surveys. We detected full choruses on two occasions in 2014, but none in 2015. To more accurately monitor populations of this species at SERC, anuran call surveys should be supplemented with throw trapping of larvae. Surveyors could also deviate from the standardized calling survey protocol and visit sites when vocalization is most likely to occur (see Hansen, 1958; Klemens, 1993).

Although Cope's Gray Treefrog (*Hyla chrysoscelis*) is widespread throughout southern Anne Arundel County, Gray Treefrog (*H. versicolor*) is typically found in more northern portions of the county and areas west of the Patuxent River (MARA, 2015). We documented Gray Treefrog at SERC, but calling activity was infrequent. Only one or two individuals were detected in 2014, and this species has not been heard since. Its appearance may have corresponded with importation and planting of native shrubbery as part of a re-vegetation project in an area in front of the Mathias Wetland.

Egg Mass Counts

Egg mass counts are a cost-effective and accurate way to monitor Wood Frog and Spotted Salamander populations (Crouch & Paton, 2000; Cook & Boland, 2005; Skidds et al., 2007). In the maximum loci method (Cook & Boland, 2005), three rounds of counting are conducted across the breeding season of both species and the maximum count obtained from any of the three rounds is used as that year's tally. In the Mid-Atlantic, there is overlap between Southern Leopard Frog and Wood Frog oviposition during the latter half of the Wood Frog breeding season (Brown & Jung, 2005). It is difficult to differentiate between Wood Frog and Southern Leopard Frog egg masses. Therefore, counts obtained from late-season samples may be unreliable. Daytime calling anuran surveys conducted early in the calling season (see Crouch & Paton, 2000) may be a better means of monitoring Wood Frog populations than egg mass counts.

We found surprisingly few Spotted Salamander egg masses after three rounds of egg mass counts at seven sites. This species is positively associated with pond hydroperiod, size, depth, and upland forest area within 1 km of breeding sites, and negatively associated with alluvium location (Skidds et al., 2007). Low abundance may be due to normal population fluctuations, lack of appropriate within-pond and upland habitat (Klemens, 1993; Egan & Paton, 2004; Skidds et al., 2007), movement of alluvial deposits (Skidds et al., 2007) associated with development of adjacent habitats, or a combination of these variables.

Wood Frog egg masses were more abundant than those of Spotted Salamander, however, over half were found at a single site (Horseshoe Bog). This site is a long-hydroperiod, temporary wetland without predatory fishes. Most of this wetland contains persistent non-woody vegetation which provided attachment substrates for many of the masses. A large portion of the wetland also contains shrub cover, which is typically not associated with Wood Frog abundance and is negatively associated with many other species. We suggest monitoring the expansion of shrub cover at this site. Ideally, at least half the wetland should remain free of woody emergent so that the physical and biological attributes remain suitable for reproduction of Wood Frog and other anurans (Volpe, 1952; Werner & Glennemeier, 1999; Skelly et al., 2002; Tupper & Cook, 2008).

CONCLUSIONS

SERC's main campus and additional parcels contain at least 93% of the anurans, 56% of the salamanders, and 53% of the reptile species recorded from Anne Arundel County, Maryland. The breeding phenology shift observed for American Bullfrog underscores the need for continued long-term monitoring. A more concentrated sampling effort in streams is necessary to detect Northern Two-lined, Northern Dusky, and Eastern Mud Salamanders. As an aside, amphibian and reptile pathogens are present at SERC (SERC unpublished data; Tupper et al., 2015). Heightened biosecurity protocols should be established (see VHS website for disinfection protocol; VHS, 2015) to reduce transmission between sites.

ACKNOWLEDGEMENTS

We would like to thank the following people for field assistance: Sonya Boldaji, Danny Boothe, Nicole Cintas, Lauren Fuchs, David Graham, Kirk Goolsby, Elias Goolsby, Kristin Jayd, and Mike Novak. Northern Virginia Community College Department of Math, Science, and Engineering (Alexandria Campus), the Northern Virginia Community College Educational Foundation, and Dan Gustafson provided financial and logistical support. Steve Roble and an anonymous reviewer provided critical feedback that helped to improve the manuscript.

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Appendix 1. Sites, abbreviations, location, and general pool type. Hog New, Vernal, and Main are collectively Hog Complex.

Site	Abbreviation	Lat	Long	Pool Type
Beaver Pond	BEPO	38°53' 27.79"	76°33'23.69"	Beaver
Camp Letts Pond	CALE	38°54' 19.26"	76°32'15.71"	Natural
CO2 Marsh	CO2	38°52' 21.66"	76°32'44.66"	Natural
Construction Pond	COPO	38°53' 14.10"	76°33'21.29"	Artificial
Contees Wetland	CONTE	38°53' 38.14"	76°32'53.66"	Natural
Glebe Bog	GLEBE	38°54' 00.04"	76°33'18.84"	Natural
Fox Point	FOPO	38°52' 55.84"	76°32'56.67"	Natural
Hog Main	HOMA	38° 52' 50.28"	76° 33' 05.08"	Natural
Hog New	HONE	38° 52' 55.29"	76° 33' 16.44"	Natural
Hog Vernal	HOVE	38° 52' 52.78"	76° 33' 07.88"	Natural
Horseshoe Bog	HOSH	38° 52' 18.75"	76° 33' 20.25"	Natural
Mathias Wetland	MATH	38° 53' 15.95"	76° 33' 17.24"	Artificial
Mill Swamp	MISW	38° 53' 01.20"	76° 34' 15.98"	Natural
North Fork	NOFO	38° 53' 37.09"	76° 33' 37.12"	Natural
O'Neill Marsh	ONEIL	38° 52' 44.68"	76° 33' 46.37"	Natural
Retaining Pond	RETAIN	38° 53' 18.38"	76° 33' 04.39"	Artificial
Snake House Wetland	SNHO	38° 53' 29.34"	76° 33' 37.22"	Natural

Appendix 2. Species abbreviations, and common and scientific names. Nomenclature follows Crother (2012).

Abbreviation	Common Name	Scientific Name
AMTO	American Toad	*Anaxyrus americanus*
BOTU	Eastern Box Turtle	*Terrapene carolina*
BUFR	American Bullfrog	*Lithobates catesbeianus*
CGTF	Cope's Gray Treefrog	*Hyla chrysoscelis*
CHFR	Upland Chorus Frog	*Pseudacris feriarum*
CRFR	Eastern Cricket Frog	*Acris crepitans*
DBTE	Diamond-backed Terrapin	*Malaclemys terrapin*
FLSK	Common Five-lined Skink	*Plestiodon fasciatus*
FTSA	Four-toed Salamander	*Hemidactylium scutatum*
GASN	Common Gartersnake	*Thamnophis sirtalis*
GRFR	Green Frog	*Lithobates clamitans*
GRTF	Green Treefrog	*Hyla cinerea*
KISN	Eastern Kingsnake	*Lampropeltis getula*
MASA	Marbled Salamander	*Ambystoma opacum*
MUDT	Eastern Mud Turtle	*Kinosternon subrubrum*
MUSK	Eastern Musk Turtle	*Sternotherus odoratus*
NBSN	Dekay's Brownsnake	*Storeria dekayi*
NGTF	Gray Treefrog	*Hyla versicolor*
NWSN	Common Watersnake	*Nerodia sipedon*
PATU	Painted Turtle	*Chrysemys picta*
PIFR	Pickerel Frog	*Lithobates palustris*
RACER	North American Racer	*Coluber constrictor*
RASN	Eastern Ratsnake	*Pantherophis alleghaniensis*
RBSA	Eastern Red-backed Salamander	*Plethodon cinereus*
RBTU	Northern Red-bellied Cooter	*Pseudemys rubriventris*
RESL	Red-eared Slider	*Trachemys scripta elegans*
RGSN	Rough Greensnake	*Opheodrys aestivus*
RISN	Eastern Ribbonsnake	*Thamnophis sauritus*
RNSN	Ring-necked Snake	*Diadophis punctatus*
RSNE	Eastern Newt	*Notophthalmus viridescens*
SESN	Smooth Earthsnake	*Virginia valeriae*
SLFR	Southern Leopard Frog	*Lithobates sphenocephalus*
SNTU	Snapping Turtle	*Chelydra serpentina*
SPPE	Spring Peeper	*Pseudacris crucifer*
SPSA	Spotted Salamander	*Ambystoma maculatum*
SPTO	Eastern Spadefoot	*Scaphiopus holbrookii*
SPTU	Spotted Turtle	*Clemmys guttata*
WOFR	Wood Frog	*Lithobates sylvaticus*
WOSN	Common Wormsnake	*Carphophis amoenus*

Shorter Contributions

Banisteria, Number 46, pages 25-27
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New Records of the Eastern Spotted Skunk in Northwestern Virginia

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The Eastern Spotted Skunk (*Spilogale putorius*) is a small carnivore that has declined across much of its geographic range, especially in the central-southern Appalachian Mountains (Gompper & Hackett, 2005; Campbell et al., 2010). This species is considered vulnerable in Tennessee and North Carolina (Chapman, 2007) and a species of moderate conservation need in Virginia (M. Fies, Virginia Department of Game and Inland Fisheries, pers. comm). In Virginia, the assumed range of the Eastern Spotted Skunk is confined to the western mountain (Linzey, 1978) and western Piedmont regions of the state (M. Fies, unpub. data). As of 2015, only thirteen counties in Virginia (Alleghany, Augusta, Bath, Frederick, Giles, Grayson, Highland, Lee, Page, Rappahannock, Roanoke, Shenandoah, and Wythe) have published records of Eastern Spotted Skunks (Handley & Patton, 1947; Campbell et al., 2010; Diggins et al., 2015; Fig. 1). Unpublished records, however, have been confirmed in at least 24 counties from photographic evidence submitted to the Department of Game and Inland Fisheries during the past 20 years (M. Fies, unpub. data).

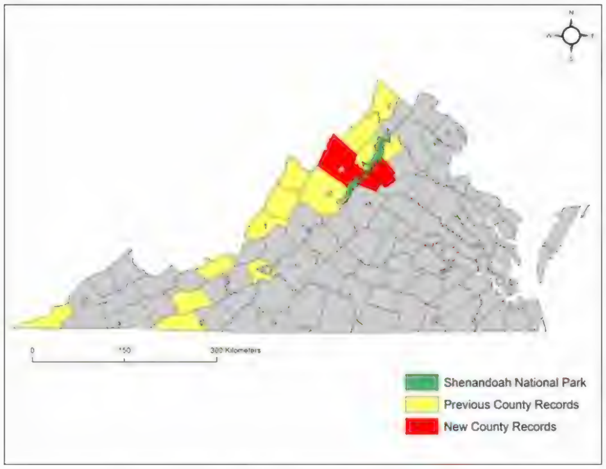

Fig. 1. Map of previously published county records (Alleghany, Augusta, Bath, Frederick, Giles, Grayson, Highland, Lee, Page, Rappahannock, Roanoke, Shenandoah, and Wythe) and new county records (Green, Madison, and Rockingham) of Eastern Spotted Skunk (*Spilogale putorius*) in Virginia.

From May to October 2015, we conducted an 18-week camera survey at 48 sites in Shenandoah National Park, ranging from the vicinity of Signal Knob Overlook (milepost 5.5) in the north to sites near Simmons Gap Ranger Station (milepost 73) in the southern portion of the Park. Our goal was to determine the presence of Allegheny Woodrats (*Neotoma magister*), Least Weasels (*Mustela nivalis*), Long-tailed Weasels (*Mustela frenata*), Fishers (*Martes pennanti*), and Eastern Spotted Skunks. Sites were located in rock outcrops and other rocky areas such as talus slopes, cliffs, cliff lines, boulder fields, and steep drainages. Typical rock outcrops were at least 10 m wide and protruded at least 0.5 m from the ground surface. We grouped sites into six clusters of 7-9 sites because distances between sites varied greatly (200-1700 m, mean = 1180 m). We conducted three 6-week survey sessions (i.e., late spring, summer, and late summer/early fall), where each cluster was sampled for seven days per survey session and site rotation was kept constant across all sessions.

We deployed two Moultrie M-880 8.0 megapixel Trail Cameras (Moultrie Inc., Alabaster, AL) 50-75 m apart at each site. When triggered, each camera took a burst of three photographs over seven seconds, which can maximize the probability of a successful detection (De Bondi et al., 2010). Due to the vertical nature of some rocky areas, we attached and secured cameras to trees at varying heights (0.25-1.5 m) depending on the rock outcrop structure. Five days prior to sampling, we placed Gusto® long-distance call lure (Caven's, Minnesota Trap Line Products, Pennock, MN) on a tree above each baited set or on the ground because the lure is known to be attractive to a wide range of carnivores (Moen et al., 2012). We placed a brown PVC tube (35.5 cm x 10 cm x 12 cm) closed at one end in front of each camera because weasels and spotted skunks are known to investigate burrows up to 30 cm deep (Frank & Lips, 1989).

Inside each tube, we placed raw meat or sardines fastened down with a 9-gauge galvanized utility wire secured to the outside of the tube. We quantified capture success as the number of trap events (i.e., photographs) per 100 trap nights multiplied by 100.

During 1,985 trap nights, we acquired >61,000 photographs of 16 mammalian and nine avian species. Eastern Spotted Skunks were detected nine times (capture success = 0.4534) at seven sites throughout the Park. Four of those sites were located in Greene, Madison, and Rockingham counties, which are the first published records of this species in all three counties. Confirmed but unpublished records previously existed for Madison and Rockingham counties (M. Fies, unpub. data). The three remaining sites were located in Rappahannock County.

The Rockingham County record was obtained on 8 August at 2109 h in a rock outcrop located in a drainage along Skyline Drive just south of Beldor Run Overlook (elevation 709 m) near milepost 71. Based on its unique pelage pattern, we were able to determine this individual was detected at the same location on 21 September at 0253 h. The habitat consisted of a closed canopy mixed oak-hickory forest. The Madison County record was obtained on 11 September at 0438 h along a trail that cuts across a talus slope on Hawksbill Mountain (elevation 1113 m). All Spotted Skunks recorded in Greene County were found on Hightop Mountain. The first one was photographed on 21 September at 0234 h at the summit (elevation 1074 m) on an exposed talus slope below a cliff face. Another individual was detected twice at a lower elevation (850 m) in closed-canopy oak-hickory forest (24 September at 2137 h and 25 September at 0554 h; Fig. 2).

The first detection in Rappahannock County occurred on 27 July at 0205 h in a rock outcrop located in a closed-canopy oak (*Quercus* spp.)-hickory (*Carya* spp.) forest (elevation 745 m) along Skyline Drive near Indian Run Overlook near milepost 10.5. The second detection occurred on 26 August at 0439 h on a ridge in a partially open canopy oak-hickory forest (elevation 833 m) northeast of Rangeview Overlook near milepost 16. The last detection in Rappahannock County occurred at 2211 h on 27 August at the edge of an oak-hickory forest at the bottom of a boulder field directly below the Mt. Marshall Overlook along Skyline Drive (elevation 869 m).

Of the seven sites where we detected Eastern Spotted Skunks, two (Madison and Greene counties) were located on talus slopes with little to no canopy cover. Although this species is known to inhabit rock outcrops (Diggins et al., 2015), they are believed to avoid areas with an open canopy to avoid predation by Great Horned Owls (*Bubo virginianus*) (Lesmeister et al., 2009). Our use of a scent-lure might explain why these individuals were detected on talus slopes. Our capture success was comparable to that reported by Hackett et al. (2007) using live traps, but lower than what was reported using cameras or track plates in Arkansas. However, as compared to an incidental live trap study in Grayson County, Virginia, our capture success was 2.3 times less (Diggins et al., 2015).

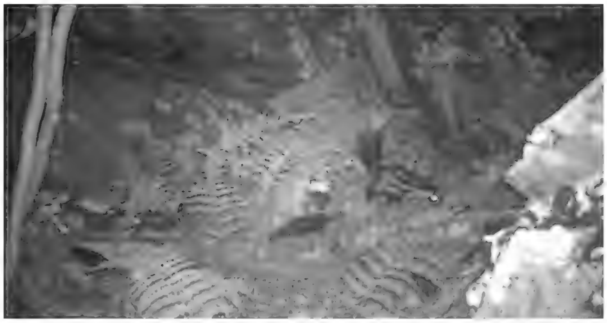

Fig. 2. Eastern Spotted Skunk (*Spilogale putorius*) in rock outcrop on Hightop Mountain on 25 September 2015 in the southern district of Shenandoah National Park, Greene County, Virginia.

Distribution of the Eastern Spotted Skunk is poorly known across the central-southern Appalachian Mountains. Our research contributes new information about the distribution of Eastern Spotted Skunks in northwestern Virginia. Despite low capture success in this study, high capture success in Missouri and Arkansas (Hackett et al., 2007) demonstrates the effectiveness of cameras in documenting the presence of Eastern Spotted Skunks.

ACKNOWLEDGEMENTS

This research was supported by a grant from the Piedmont-South Atlantic Cooperative Ecosystems Studies Unit of the National Park Service. We are appreciative of the logistical assistance and housing provided by the National Park Service – Shenandoah National Park and thank the Warnell School of Forestry and Natural Resources at the University of Georgia for providing additional logistic assistance over the course of this study.

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Banisteria, Number 46, pages 27-28
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An Instance of Geophagy by Pileated Woodpecker (*Dryocopus pileatus*) in the Great Dismal Swamp

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Avian geophagy can serve several functions (Ziswiler & Farner, 1972; Diamond et al., 1999; Gilardi et al., 1999; Gionfriddo & Best, 1999). Coarser particles and grit aid in the trituration or grinding of food in the gizzard, whereas finer particles (< 63 µm) may provide minerals and act to buffer toxic or bitter compounds in the diet. Most granivorous and herbivorous birds, as well as many insectivorous species, are believed to ingest grit (Ziswiler & Farner, 1972). However, the checklist of avian families and species for which geophagy or grit consumption has been documented is surprisingly limited (see Gionfriddo & Best, 1999). Of interest here is the absence of reported geophagy or grit consumption among the dozens of papers that have addressed the diet of Pileated Woodpecker (*Dryocopus pileatus*) across its vast North American range (Bent, 1939; Bull & Jackson, 2011).

On 24 May 2001, I observed a Pileated Woodpecker on Lynn Ditch Road (36° 42.4' N; 76° 31.6' W) about 1.0 km south of Jericho Ditch Lane, in the Great Dismal Swamp National Wildlife Refuge (GDSNWR), City of Suffolk, Virginia. The woodpecker was vigorously pecking the sandy soil exposed in the parallel tire tracks atop the road, which is the only dry soil in this sector of the swamp in spring (Graves, 2001). I watched the bird through 10 × 40 binoculars from a distance of 40 m for about a minute until it flew. The woodpecker made swallowing motions several times but I could not tell what was being consumed. After the woodpecker flew I closely examined the disturbed soil. I found no evidence of ants, ant burrows, or other insects in or around the clustered bill marks (1–2 cm deep). I concluded that the woodpecker had been consuming soil, which I collected for future analysis. This constituted my sole observation of geophagy by Pileated Woodpeckers during 16 field seasons (1989-2006) in the Great Dismal Swamp.

Lynn Ditch Road was constructed with dredge spoils from the adjacent ditch (prior to the 1930s). Soil adjacent to the road is classified as Belhaven muck (Natural Resources Conservation Service, 2015), rich in organic matter with a high water table. Sandy soils on the road surface likely represent the upper member of the underlying Sand Bridge formation (Oaks & Coch, 1963) dredged from the bottom of the ditch. However, road surfaces have also been augmented by soils hauled in from the nearby Suffolk Scarp, a sandy Pleistocene shoreline that forms the western boundary of the Great Dismal Swamp (Oaks & Whitehead, 1979). Roads represent the only source of grit in much of the swamp. The nearest natural source of grit lies ~2.75 km west of the geophagy site on the Suffolk Scarp. The soil sample was strongly acidic (pH = 4.8) and composed of fine sand (85% by weight), silt, and clay (12.5% by weight, particle size < 63 µm), and a few coarser quartz grains (> 2 mm). A bulk soil sample was analyzed by the Agricultural Analytical Services Laboratory, Pennsylvania State University. The cation exchange capacity (CEC) was moderately low (11.8 meq/100 g) and levels of key nutrients were similarly moderate — phosphorus (28 ppm), potassium (126 ppm), calcium (675 ppm), and magnesium (75 ppm). Thus, it seems likely that the woodpecker consumed the sandy soil primarily to aid trituration of hard food items rather than as a source of minerals or to buffer toxic dietary compounds.

ACKNOWLEDGMENTS

I thank Jerry Jackson and Don Schwab for helpful comments on the manuscript and the US Fish & Wildlife Service (USFWS) for permission to conduct research in the GDSNWR. Funding was provided by the Alexander Wetmore Fund, the USFWS, and the Smoketree Trust.

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Banisteria, Number 46, pages 29-30
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Snowy Owl Brings New Record of Chewing Louse to Virginia

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The Snowy Owl (*Bubo scandiacus*) is a resident of the Arctic tundra with a circumpolar distribution. For reasons not entirely known, but believed to be related to unusually high breeding success in the summer and scarcity of food (primarily lemmings and voles) the following winter, particularly young owls disperse far south in search of food (Holt et al., 2016). In the winter of 2013-2014 there was an unusually large incursion of Snowy Owls into the temperate zone of North America. Virginia was near the southern end of this mass irruption and there were numerous sight records of the large white owls from Virginia. Snowy Owls were sighted in Dutch Gap, Chesterfield Co., Bridgewater, Dayton, and Mt. Crawford, Rockingham Co., Yorktown Battlefield, York Co., Kiptopeke State Park, Hog Island, Fisherman's Island, and Cape Charles, Northampton Co., Chincoteague and Queen Sound, Accomack Co., Reagan National Airport, Arlington Co., Glen Allen, Henrico Co., the Rappahannock River Valley National Wildlife Refuge, Richmond Co., and the cities of Hampton, Richmond, and Virginia Beach (Virginia Birds, 2014). Other records were from the Springfield Mall, Fairfax Co., Dulles International Airport, Loudon Co., and Manassas Regional Airport, Prince William Co. (eBird, 2016). It is likely that there were numerous sightings that were not recorded and some of the above sightings may have been of the same bird.

In addition to sight records, two of the Snowy Owls present at Reagan National Airport were struck by airplanes and died. One owl (FAA, 2016) was sent to the Feather Identification Lab at the National Museum of Natural History and prepared as a study skin (USNM 652721). While preparing the study skin of this female bird killed on 3 February 2014, one of us (JW) noted and preserved several ectoparasites. The ectoparasite sample saved was a portion of a larger population and consisted of 5♂, 3♀ adults, and 2 nymphs. The parasites were identified as the chewing louse, *Strigiphilus ceblebrachys* (Denny, 1842) (Fig. 1), which is a member of the Order Phthiraptera, Suborder Ischnocera, and Family Philopteridae, and is a new record for Virginia. Specimens were preserved in 95% ethanol, partially cleared in a dilute KOH solution overnight, dehydrated in an ethanol series, cleared in xylene and mounted on slides in Canada balsam. The lice were identified using the keys and figures in Price et al. (2003) and Clayton & Price (1984). Specimens have been deposited in the Entomology collections of the National Museum of Natural History, USNMENT 01193750, 01193777, 01193825, 01193826, 01193855, 01193892, 01193985.

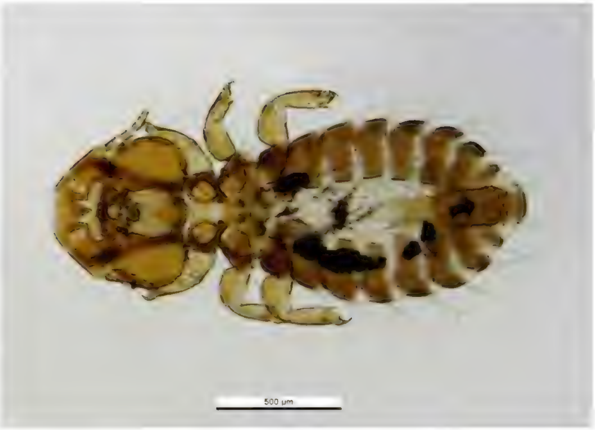

Fig. 1. Male *Strigiphilus ceblebrachys*, USNMENT 01193985.

Strigiphilus ceblebrachys is apparently a host specific parasite of the Snowy Owl and has not been documented with certainty to parasitize any other host species (Clayton, 1990). There are published records of *S. ceblebrachys* in the United States from Maine, New Hampshire, Washington, North Dakota, Minnesota, Wisconsin, Indiana, and New York (Peters, 1932; Clayton & Price, 1984). Virginia appears to be the southern-most known locality for *Strigiphilus ceblebrachys* in the United States.

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Banisteria, Number 46, pages 31-37
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How Ecology and Land Use History Shaped the Battle of Chancellorsville

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ABSTRACT

The Battle of Chancellorsville (1-3 May 1863) in Spotsylvania County, Virginia, has often been regarded as one of the pivotal battles of the Civil War. Extensive deforestation to support the local iron industry beginning in the early 1700s resulted in a very dense coppice forest known as "The Wilderness," which from historical accounts was likely characterized by successional oaks (*Quercus* spp.), pine (*Pinus* spp.), and evergreen "tanglefoot" (probably greenbrier, *Smilax* spp.). The Wilderness played a critical role in the outcome of the battle by influencing Union troop positions, severely limiting visibility, and providing cover for Confederate maneuvers. Uncontrolled wildfires in the Wilderness also claimed the lives of many of the wounded on the battlefield. Even the mortal wounding of Stonewall Jackson by his own men may be linked, in part, to the land use history and ecology of the battlefield because of the confusion caused by the wildfires and dense vegetation. This manuscript aims to explore first how the Wilderness came to be formed prior to battle, and secondly how the forest directly influenced the outcome of Chancellorsville using accounts provided by the men who fought in the battle.

Keywords: Chancellorsville, Civil War, vegetation, land use history, wildfire, coppice forest.

INTRODUCTION AND LAND USE HISTORY

Land use history is frequently used to explore the vegetation composition of modern forests. However, forest composition and land use history are less frequently correlated to results of major events in human history. The Battle of Chancellorsville (hereafter referred to as "Chancellorsville[1]") is one such event in American history that was appreciably defined by the forest community in which it occurred.

The battlefield is located in Spotsylvania County, Virginia and lies on the divide separating the watersheds of the Rappahannock River from the Po and Ni rivers (National Park Service, 1986, 2012; Taverna & Patterson, 2008). The terrain is rolling to locally hilly with elevations ranging from 80-95 m along streams and valleys to 135 m along scattered ridges (Orwig &

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[1] "Chancellorsville" is not a city, community, or other municipality within Virginia. Prior to the Civil War, a large mansion owned by the Chancellor family existed at the intersection of the Plank Road and Orange Turnpike, deep within the Virginia Wilderness. The area was (and still is) colloquially known as "Chancellorsville" (Gray, 2011).

Abrams, 1994b; Taverna & Patterson, 2008). Numerous streams and swamps on gently rolling wooded plateaus dissect the battlefield (National Park Service, 1986, 2012; Taverna & Patterson, 2008).

Spotsylvania County is located within the Piedmont Plateau physiogeographic province (Orwig & Abrams, 1994a). The composition of mature hardwood Piedmont communities varies with soils and topography (Fleming, 2012; Weakley et al., 2012). Prior to European settlement, Native Americans introduced fire to the Virginia landscape frequently enough to create savannah-like grasslands that featured sparse trees within the Piedmont (Beverly, 1947; Brender, 1974; Vale, 1982; Russell & Schuyler, 1988; Orwig & Abrams, 1994b; Fowler & Konopik, 2007; Fleming, 2012; Weakley et al., 2012). At the time of European contact, deciduous trees characterized most of the forested Piedmont—primarily oaks (*Quercus* spp.) and hickories (*Carya* spp.) (Braun, 1950; Sharitz et al., 1992). Shortly after European settlement, the fire-maintained grassland prairies all but disappeared (Fleming, 2012; Weakley et al., 2012).

From 1721-1863 most of the Virginia Piedmont forests were cleared in favor of agriculture and westward expansion (Orwig & Abrams, 1994b; Fleming, 2012; Weakley et al., 2012). However, many of these early farms were subsequently abandoned as a result of poor agriculture practices, and much of the Piedmont was eventually reforested with early successional species prior to the Civil War (Orwig & Abrams, 1994b). Through the course of the Civil War, most of central and eastern Virginia were once again cleared (Orwig & Abrams, 1994b).

Europeans first settled Spotsylvania County in 1721 (Orwig & Abrams, 1994b), but expansion into the area around what would become the Chancellorsville battlefield was slow prior to the Revolution in large part due to the hilly landscape which was only marginally usable for agriculture (Auwaerter et al., 2010). Instead of traditional agriculture, this area was characterized by a growing iron industry (Cappon, 1945; Mansfield, 1977; Auwaerter et al., 2010). Lieutenant Governor Spotswood (the namesake for Spotsylvania County) established the first successful iron mines in the Virginia Frontier between 1718 and 1720, and to feed his new industry Spotswood acquired much of the land that would become the battlefield (Auwaerter et al., 2010). Following Spotswood's death in 1740, his family continued to operate family furnaces and mining operations in the area; Catherine's Furnace (Fig. 1), was established sometime in the 1840s within a few kilometers of the Chancellor's Mansion and can still be seen today.

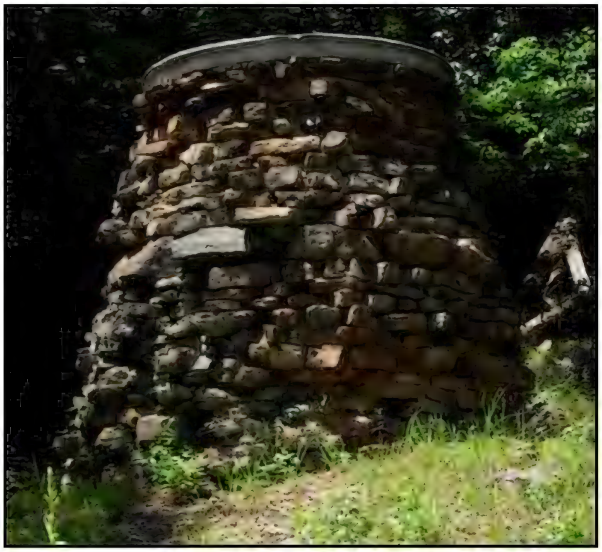

Fig. 1. Catherine's Furnace as it appeared in 2014. Photo by Robert H. Floyd.

Eighteenth and nineteenth century iron furnaces were fueled by hardwood charcoal that could require 400-800 ha of deforestation annually, and harvesting might be repeated as frequently as every 25 years (Whitney, 1994; Johnson et al., 2009). As early as 1732, Colonel William Byrd recounted passing through a second-growth forest plantation in the area that he described as "poisoned fields, with nothing but saplings growing on them" (Auwaerter et al., 2010). Colonel Byrd's "poison fields" are believed to have been woods hastily clear-cut to fuel the Spotswood iron furnaces (Auwaerter et al., 2010). These logging practices resulted in very dense, oak-dominated coppice forests (Taverna & Patterson, 2008), and by the time of the battle this densely vegetated, heavily disturbed area was colloquially known as "The Wilderness" (Official Record, 1887a: 889; Luvaas & Nelson, 1988). At the time of the battle, the Wilderness was an approximately 112 x 28 km stretch of second growth timbers, briers, thick underbrush, with occasional streams that made the terrain nearly impenetrable (Steckler & Blachley, 2000). It should be noted, however, at least some canopy trees—likely pines or other species that were less desirable for fueling a furnace—must have remained, because there are accounts of Union observers who climbed tall trees in an attempt to ascertain Confederate movements during the battle (Cullen, 1966; Luvaas & Nelson, 1988).

Limited information exists as to the exact species composition at the time of the battle; however, many accounts describe Chancellorsville as having been fought in "dense mid-story thickets" (Foote, 1963;

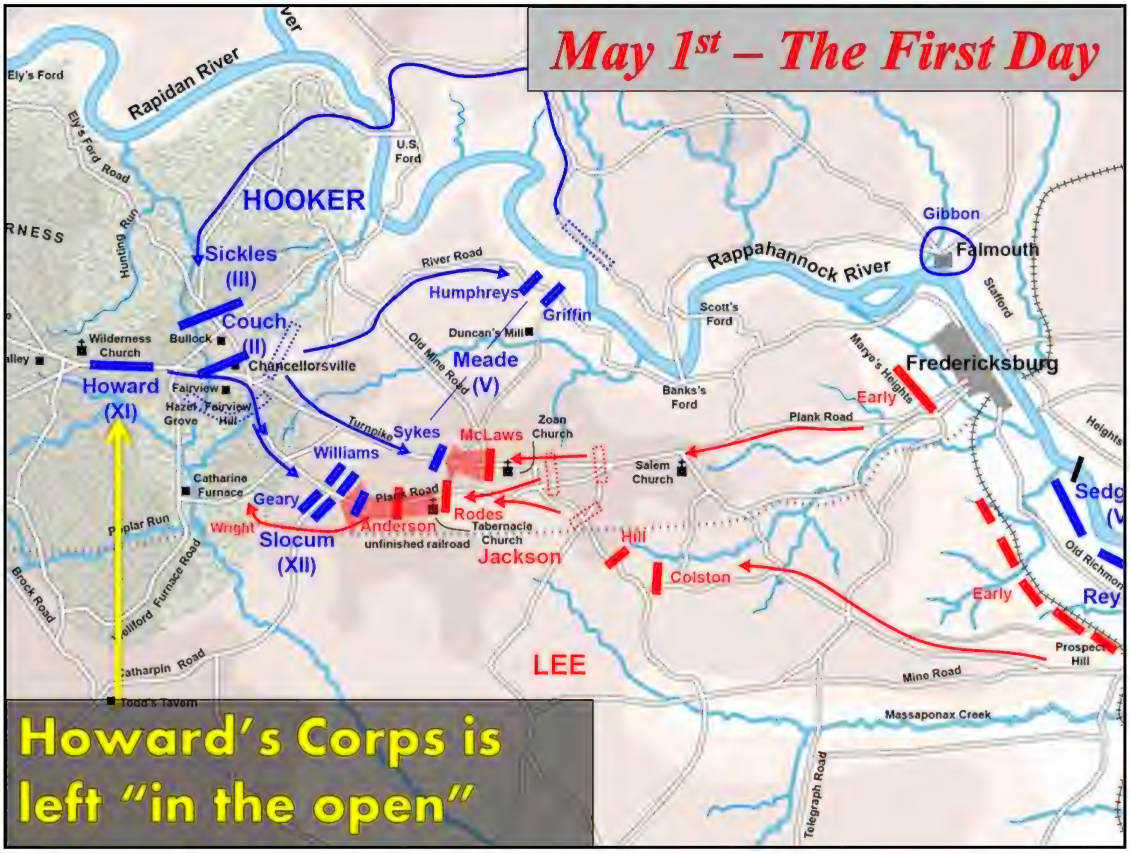

Fig. 2. The battle at Chancellorsville, 1 May 1863. Map by Jespersen (2014). This file is licensed under the Creative Commons Attribution 3.0 license and has been modified by the authors for use in this manuscript.

Gallagher, 1996) that would be consistent with a coppice forest. Cullen (1966) described the landscape as it appeared in 1863 as a dense forest of second-growth pine and scrub oak with numerous creeks, gullies, swamps, "heavy tanglefoot underbrush" (probably greenbrier, *Smilax rotundifolia*), and few farms or open spaces. An interpretive sign at the battlefield today speculates that the cutting operations left the landscape with emergent pines (*Pinus* spp.), stunted oaks (*Quercus* spp.), vines, greenbrier (*Smilax* spp.), and honeysuckle (*Lonicera* spp.). Several accounts are also provided in the official battle reports provided by officers on both sides. Confederate Colonel John T. Mercer provided one such account in which he described marching through "oak timber" and "strips of pine bushes" (Official Record, 1887a: 971; Luvaas & Nelson, 1988).

EFFECTS OF THE WILDERNESS ON THE BATTLE

The battle began on 1 May 1863 when Confederate General Robert E. Lee dispatched Lieutenant General T. J. "Stonewall" Jackson to attack the Union Army of the Potomac, commanded by Major General Joseph Hooker, on the south side of the Rappahannock River along the eastern edge of the Wilderness (Cullen, 1966) (Fig. 2). Hooker's response was to withdraw deeper into the Wilderness to prepare for a general engagement. However, Hooker positioned his army almost exclusively within the clearings and roadways that were cut through the Wilderness (Official Record, 1887a: 865-866; Luvaas & Nelson, 1988).

Major General Oliver O. Howard's XI Corps occupied the westernmost position held by the Union, and they likewise established camp along the cleared areas adjacent to the Plank Road (Official Record, 1887a: 630; Luvaas & Nelson, 1988). Notably, Howard's Corps failed to "anchor" the western end of the Union Army to a river or otherwise defensive position (Fig. 2) because the seemingly impenetrable coppice forest made maneuvers difficult and navigation very challenging. Swinton (1882) provided this description of the Wilderness: "It is impossible to conceive a field worse adapted to the movements of a grand army."

Having discovered Howard's position, Confederate Generals Lee, Jackson, and Stuart developed a strategy that would use the Wilderness to shield troop movements around the Union position (Foote, 1963; Gallagher, 1996). The sheer density of the Wilderness was key to Confederate success, and the presence of evergreen species may have played a role. Union Brigadier General Alpheus S. Williams made reference to this aspect of the forest composition when he described his brigade "penetrating dense evergreen thickets" (Official Record, 1887a: 708; Luvaas & Nelson, 1988). General Williams may also be referring to abundant greenbrier, but it is reasonable to speculate from other accounts that pine (Official Record, 1887a: 925), American holly, mountain laurel (*Kalmia latifolia*), and other successional species could have also been present at the time.

On May 2nd at 0700 h, Stonewall Jackson led approximately 28,000 Confederates on a 12-mile road march south and west around the Union position, and throughout most of their maneuver, Jackson's men and his intentions were effectively shielded from Union observers (Foote, 1963; Wineman, 2013). If Jackson's movements had been detected and understood, Hooker's main force could have easily overwhelmed the remaining Confederate forces at the east of the Wilderness, and the entire Army of Northern Virginia would have likely been defeated piecemeal (Luvaas & Nelson, 1988).

In his official report following the battle, General Howard attributed the dense Wilderness as the primary reason for the disaster that befell his Corps: "the woods was so dense that he [Stonewall Jackson] was able to mass a large force, whose exact whereabouts neither patrols, reconnaissances [sic], nor scouts ascertained. He succeeded in forming a column opposite to and outflanking my right" (Official Record, 1887a: 630; Luvaas & Nelson, 1988).

The Confederates were remarkably successful in their initial attack, which drove fleeing Union forces deep into the Wilderness, and continued until nightfall (Foote, 1963; Gallagher, 1996). However, the Confederate attack ultimately stalled and coordination deteriorated. Confederate Brigadier General Raleigh E. Colston attributed much of this confusion to nightfall and "the very difficult and tangled nature of the ground over which the troops had advanced" (Official Record, 1887a: 1004-1005; Luvaas & Nelson, 1988).

By 2300 h Stonewall Jackson became agitated that the battle had stalled, and to assess the feasibility of a night attack, he rode beyond the Confederate picket lines and was mistakenly fired upon by his own men (Foote, 1963; Gallagher, 1996). It is reasonable to assume that the dense vegetation and sporadic wildfires contributed to the general chaos associated with the "fog of war," and it was within this confusion that Jackson was mortally wounded. Nearly one year later at the Battle of the Wilderness, Confederate General James Longstreet would also be wounded by friendly fire while navigating through the same dense vegetation only a short distance from the place where Jackson was shot (Steckler & Blachley, 2000). Following Jackson's wounding, command of his corps was transferred first to Major General A.P. Hill, who was wounded soon thereafter, and subsequently to Major General J. E. B. Stuart (Foote, 1963; Luvaas & Nelson, 1988).

By morning on May 3rd, the Union had concentrated its forces around the Chancellor's mansion and along an open stretch of ground extending southward to an adjacent cleared hilltop called Hazel Grove. Once again the Confederates used the Wilderness to shield their maneuvers: "About sunrise we moved forward to the attack, through dense pine timber, driving before us the enemy's skirmishers, and at a distance of 400 yards [366 meters], emerging into the open field in front of a battery, which was placed on an abrupt hill [Hazel Grove] near a spring-house" (Official Record, 1887a: 925; Luvaas & Nelson, 1988). After taking Hazel Grove, Confederate artillery were directed toward the Chancellor's mansion; the Wilderness on three sides provided an effective shooting lane for the Confederates (Fig. 3), who effectively bombarded the mansion and left General Hooker with a serious, albeit non-fatal, head injury (Foote, 1963).

By day's end, Generals Lee and Stuart had effectively routed Hooker's army, which retreated deep within the Wilderness (Cullen, 1966). On 6 May 1863, the entire Union Army of the Potomac retreated once

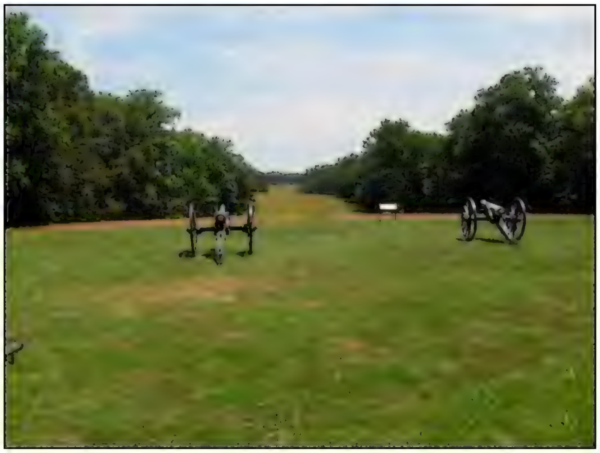

Fig. 3. Stuart's position at Hazel Grove facing the Chancellor's Mansion, which in 1863 would have been clearly visible at the end of the clearing. Photo by Robert H. Floyd.

again north of the Rappahannock River (Foote, 1963; Cullen, 1966).

DISCUSSION

With over 30,000 casualties at the conclusion of the battle, Chancellorsville was to that date the bloodiest conflict ever fought in North America.[2] Amid the fighting, wildfires erupted throughout the Wilderness causing attack lines to stop, and many of the wounded failed to escape the flames (Foote, 1963). Private John O. Casler (CSA) provided one such account: "The woods, taking fire that night from the shells, burn rapidly and roasted the wounded men alive. As we went to bury them, we could see where they had tried to keep the fire from them by scratching the leaves away as far as they could reach. But it availed not; they were burnt to a crisp" (Casler, 1906). Flames with such high intensity may reflect considerable fuel accumulation within the O- and A-horizons over the course of many years. We were unable to find a published post-settlement fire history for the Wilderness, but more than 100 years of fire-suppression since European contact would have resulted in significant fuel accumulation at the time of the battle. Likewise, a coppice forest characterized by dense sprouts could have also accumulated considerable amounts of fuel in a relatively short amount of time. Confederate Brigadier General James H. Lane also made reference to the intensity of the fires in his official report: "the woods which we entered were on fire; the heat was excessive […] the dead and dying of the enemy could be seen on all sides enveloped in flames, and the ground on which we formed was so hot as at first to be disagreeable to our feet" (Official Record, 1887a: 917-918; Luvaas & Nelson, 1988).

Almost one year after Chancellorsville, both armies would clash again in the Virginia Wilderness in another major confrontation named "The Battle of the Wilderness," which was also characterized by spot fires and dramatic conflagrations throughout tangled thickets (Foote, 1963; Cullen, 1966). At Chancellorsville, the Union deliberately avoided the dense woods of the Wilderness, whereas at the Battle of the Wilderness the Union adopted the opposite strategy and elected to maneuver within the Wilderness. However, according to the official report by Major General Gouverneur Warren (USA), "the thick woods caused much confusion in our lines," and his attack on 5 May 1864 ultimately failed because an adjacent Union line was unable to protect Warren's flank, "on account of the woods" (Official Record, 1887b: 540).

THE CHANCELLORSVILLE BATTLEFIELD TODAY

Today, the Chancellorsville Battlefield is part of the Fredericksburg-Spotsylvania National Military Park (FSNMP), was designated for Federal preservation in 1927, and has been under Department of the Interior stewardship since 1933 (National Park Service, 1986, 2012). Although logging continued in the vicinity of the battlefield through the early 1990s, the Wilderness forests today are physically mature and far different from that of the Civil War-era stands (Taverna & Patterson, 2008). Taverna & Patterson (2008) characterize the most common stand type within the modern-day Chancellorsville Battlefield as "Oak/Heath Forests," which the United States National Vegetation Classification (USNVC) describes as a Piedmont / Low Elevation Mixed Oak / Heath Forest (USNVC code CEGL008521) (Taverna & Patterson, 2008). Typical canopy species include oaks, hickories, red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), sweetgum (*Liquidambar styraciflua*), and tulip-poplar (*Liriodendron tulipifera*) (National Park Service, 1986). Sub-canopy vegetation includes dogwoods (*Cornus florida*), red cedar (*Juniperus virginiana*), black gum, mountain laurel (*Kalmia latifolia*), sassafras (*Sassafras albidum*), and other shrubs (National Park Service 1986). Wetlands and creeks extend through the battlefield park and include, among others, Coastal Plain / Piedmont Floodplain Swamp Forests (conservation rank G3G4) and Coastal Plain / Piedmont Acidic Seepage Swamps (Taverna & Patterson, 2008). In a study of the Fredericksburg-Spotsylvania Battlefield Parks, Orwig & Abrams (1994b) found comparatively less evidence of successional change in the upland forests of Chancellorsville, as compared to other Virginia battlefields. This phenomenon may be attributed to Nason, Tatum, and Catharpin soils which are characterized as somewhat impermeable clayey subsoils with moderate shrink-swell potential (Elder, 1985; Taverna & Patterson, 2008).

The National Park Service seeks to preserve the historic scenes and resources of the Chancellorsville Battlefield—and all of the FSNMP—by minimizing the impact of land use changes adjacent to the battlefields, and to present the park's historic sites to visitors in a manner that promotes education and America's Heritage (National Park Service, 1986). Their approach includes active management of forest conditions including, but not limited to, prescribed fire application, invasive species management, and maintaining and restoring open areas that existed at the time of Chancellorsville (National Park Service, 1986, 2012).

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[2] By the end of the Civil War, Chancellorsville was only the fifth bloodiest battle, following Gettysburg, Vicksburg, Spotsylvania Courthouse, and The Wilderness (The Civil War Trust, 2014).

It is perhaps worth noting that although the Wilderness no longer resembles the coppice forest that existed during the battle, the FSNMP General Management Plan (National Park Service, 1986) does not indicate a desire to return the Wilderness to the heavily disturbed condition that existed in 1863. Perhaps a point of future debate, presumably the caustic effects of replicating extensive nineteenth century logging practices on the contemporary landscape outweigh the value of returning the Wilderness to its condition at the time of the battle. Nevertheless, Chancellorsville is one of the most well-preserved American battlefields, and remains a valuable resource to our national, military, and natural heritage.

ACKNOWLEDGEMENTS

We would like to thank Ms. Natalie Floyd, Ms. Debbie Threadgill, Mr. Gregg Kneippe, the National Park Service, Dr. Mark Abrams, the late Shelby Foote, Mr. Hal Jesperson (www.cwmaps.com), The Fredericksburg-Spotsylvania National Park: Chancellorsville Unit and Stonewall Jackson Shrine Unit, and most notably the more than 620,000 American Patriots who gave their lives from 1861-1865 and those who work to preserve their memory.

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Banisteria, Number 46, pages 38-48
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Charles Elmo Stevens, Jr. (1926-2015) Tribute to a Naturalist

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Mo Stevens as a young birder. Photo by Bill Minor.

On October 7, 2015, we lost a stalwart of Virginia natural history in the passing of Mr. Charles E. (Mo) Stevens. Mo was born May 2, 1926, in Charlottesville, Va., to Charles Elmo and Hellen Goodyear Stevens. As a youth, he joined the Boy Scouts and attained the rank of Eagle Scout. He soon developed a keen interest in birds and began a lifetime of long treks in the countryside documenting the local avifauna, and later the plant life of the entire state of Virginia and neighboring parts of West Virginia, with occasional visits to the more distant lands of Maine, Panama, and Ireland.

Mo graduated from Lane High School in 1943 and enlisted in the U.S. Army on September 4, 1944. He was assigned to the 102nd infantry division, nicknamed "Ozark", which had been activated in September, 1942, at Camp Maxey, Texas. The division assisted with the war campaign in Rhineland and central Europe and returned in March, 1946. Mo served in the 407th infantry regiment which maintained the battle line along the Roer River near Linnich, Germany (infantryozark.blogspot.com). Mo recounted that his unit was captured by the Germans very close to the end of the war. Apparently, he had some sort of field guide to birds with him in the trenches, as years later he humored his listeners with slightly differing versions of the story.

After the war, Mo returned to his beloved Albemarle County and entered the University of Virginia in 1947 majoring in geology, which not only fascinated him, but was, in later years, instrumental in his explorations for plants. In the years following, Mo established lifelong friendships with birders such as Fred Scott, Robert J. ("Jim Bob") Watson, Bill ("Willie") Minor, and Ken Lawless, some of whom served the Virginia Society of Ornithology for many years. The 1951 yearbook, Cork & Curls, lists his activities as Theta Delta Chi fraternity, Rogers Society and the "Cavalier Daily", UVa's student newspaper. He was very active with his fraternity, and the Rogers Society, named for famed 19th century geologist, physicist, and educator at the University of Virginia, William Barton Rogers, speaks to his study of geology.

In 1951, Mo married Sarah Todd Fletcher ("Toddy"), with whom he raised their three children at Preston Place in Charlottesville where he was visited by many botanists and birding friends.

Initially, Mo aspired to become a professional ornithologist but was discouraged by uninspiring biology instructors, so he turned to geology which also fascinated him (Field, 1978). Even many years later, he spoke fondly of Brooks Hall and the geology collection housed there. Graduating with a degree in geology in 1951, with his young bride, he initially headed off to Texas where he worked for several years as a geologist exploring for oil (Field, 1978). He soon tired of the constant moving around, and by winter of 1956, he was back in Charlottesville. He worked as a cashier and trader at the Wiley & Thornhill brokerage firm (Minor *in* Gaden et al., 2010), where his talents of systematic organization and record-keeping found utility in the brokerage industry (and later at the University of Virginia Hospital Controller's Office, then the Department of Credit and Collections), but even more so in the field of natural history. His passion continued to be in the field making observations and forging connections between geology, physiography, vegetation, and the distributions of birds and plants.

In his late 40's, initially concerned that he was gaining weight, but also desiring to keep in shape for walking in the mountains, Mo took up long distance running which he approached with the same enthusiasm and dedication he brought to all his endeavors. He began running with the local running club, but it wasn't long before he was entering local 5K and 10K races. Initially, he didn't think he'd ever run a marathon, but at age 51, he ran in the Marine Corps Marathon with "the embarrassingly slow time of 4 hrs, 16 min." (CES to John Pancake, letter dated 11-14-1977). This was the first of quite a few marathons, and though he wasn't particularly fast, he always finished.

In the 1960s, Mo's interests shifted primarily to botany, forged in large part by his acquaintance with Dr. Alton M. Harvill, Jr., of Longwood College. Though his interest in birds never waned, the magnitude of the task of learning plants and working out their distributions consumed the remainder of his life. He was always eager to explore, and even after he wasn't able to drive, he never turned down an opportunity to go out in the field.

Mo was truly an autodidact, mastering the vocabularies of geology, ornithology, and botany. Outings with him were such fun because he shared his knowledge with generosity and modesty. He entertained with wit and whimsy and could discuss just about anything with authority. He was equally comfortable with professionals and novices alike, as everyone enjoyed his ever-questioning mind, numerous interests, and especially, his sense of humor. He was a prolific letter writer and the following accounts borrow heavily from this correspondence as a way of communicating the breadth of his curiosity and his ever present wittiness. In addition, several individuals who knew him well have generously communicated some of their recollections.

MO, THE BIRDER

Mo taught himself birds at an early age which he pursued relentlessly with his good ears and sharp eyes and which he learned to identify by the least chirp. Warblers were abundant in his yard on 2nd Street in Charlottesville during migration, and he would leave his window open at night and listen to the calls of the warblers and other birds as they flew over. Importantly, he also recorded these observations assiduously in small, pocket-sized, black notebooks. He recounted that, as a boy, his father would drive him out into the county to a destination he wanted to bird, and he would walk back to town, or occasionally hitch a ride. Thus began a lifetime of long walks for which he became renowned. Through scouting, he became a close, life-long friend with Bill Minor with whom he would camp, backpack, and go birding. As a teenager, Mo published the first of many ornithological observations in *The Raven* in 1944, the sighting of a White Ibis along the Rivanna River at Charlottesville.

Mo and Bill were drafted into military duty, but both returned to Charlottesville after the war and attended the University of Virginia, picking up their birding together as time permitted. During his time away, another birder had moved to Charlottesville, Rev. John H. Grey, Jr., minister at the First Presbyterian Church. Rev. Grey spearheaded formation of Turkey Sag Bird Club, a name which Mo suggested. In 1946, Mo took over as compiler of the Charlottesville Christmas Bird Count. The following year, Turkey Sag hosted the Virginia Society of Ornithology's annual meeting. In 1949, with Rev. Grey, Mo published an article on the birds of Albemarle County (Minor *in* Gaden et al., 2010). From that time on, he became the keeper of all things ornithological in the county for the next sixty years! These records eventually resulted in publication of a checklist of birds of Albemarle County (Minor & Stevens, 1997, 2000). Mo also benefited from his association with prominent Virginia ornithologists Dr. Ruskin Freer and Dr. J.J. Murray, both founding members of the Virginia Society of Ornithology who regularly published their bird observations in *The Raven* which Murray edited for almost 40 years, and thus included most of Mo's bird sightings and reports.

From the beginning, Mo had a strong parochial interest in Albemarle County. To get more records for the county, he started two additional Christmas bird counts, the Warren Count in 1947 in southern Albemarle, and the Big Flat Mountain Count in the Blue Ridge along the county's northwestern border in 1956. The first year of each he was the only observer! During his college years, Mo expanded his birding activities throughout the state by participating in Virginia Society of Ornithology forays and birding trips with Bill Minor and Fred Scott, in particular. Mo was particularly enamored with the avifauna of the high mountain regions, especially the spruce-fir areas but also the many isolated old growth hemlock stands with their immense trees spared from the saw due to the fact that tanneries were mostly in West Virginia, too far away to be profitable for this otherwise unmerchantable timber. Mo published his observations regularly through the 1960s, but this habit dropped off precipitously as his interest turned to botany in the late 1960s, and took over in the 1970s. Mo had a lifetime membership in the Virginia Society of Ornithology which he joined in 1944 (Raven 62(2):84).

MO, THE BOTANIST

As a young man, before becoming acquainted with any botanists, Mo got interested in ferns, undoubtedly spurred by Edgar T. Wherry's popular Guide to Ferns, which Mo cherished. A registry of membership indicates that he joined the American Fern Society in 1961 (Fiddlehead Forum 1(4) - 1974).

From his early days of birding, Mo had become acquainted with and was a strong admirer of Dr. Ruskin S. Freer, a professor at Lynchburg College. Dr. Freer wrote a weekly column, "The Rambler", for the Lynchburg News, and Mo subscribed to the Sunday paper just to read his nature column. When Dr. Alton Harvill of Longwood College learned from Dr. Freer of Mo's familiarity with remote parts of the Virginia landscape, he wrote a letter of introduction. Within a few months they had arranged a foray together, initiating a friendship that lasted until Dr. Harvill passed away in 2008 (Wright, 2011). Thus began an association that took them all over Virginia as well as to the Smithsonian Institution and Philadelphia Academy of Sciences where Mo searched for "new" county records of Virginia ferns and other plants as time permitted.

After a Botany Section was formed within the Virginia Academy of Sciences by approval of its Council in October, 1969, a Flora Committee was formed with Dr. Harvill as chair, and he was eager to get Mo involved. Dr. Harvill introduced a project to produce an atlas of the plants of Virginia with the idea of eventually producing a manual of the state's flora, a model successfully employed by botanists from the University of North Carolina. He convened a meeting in November at Lynchburg College to form guidelines for publication of a Virginia flora. Towards this end, certain individuals volunteered to work on particular plant groups and to collect from various regions of the state. These are outlined in the January 1970 issue of *Jeffersonia* in which C.E. Stevens is listed as the contributor for Pteridophyta to collect in "Albemarle Co. west, southwest, & northwest." (Newsletter, VAS Flora Committee 4(1):1-4). Mo met the task of mapping Virginia's pteridophyte flora head on. Building on the wealth of knowledge he'd acquired from rambling all over the state in search of birds, observing geology and vegetation, he was primed to contribute at a staggering pace. He quickly gained a reputation beyond the birding circles for his marathon walks into remote areas often over very rugged terrain. As with birds, it was to the mountain region that he initially turned his focus, but he soon expanded efforts to all parts of the state. He collected geological maps and Division of Mineral Resources publications that provided insights into correlations between plants and their geologic substrates, clues to finding species in counties where they hadn't yet been recorded. USGS topographic maps were cheap ($0.25) initially, and he poured over them searching for interesting topographies and planning long walks. He eventually had 7.5" maps for most of the state on which he recorded the exact locations of many species that interested him. The accuracy with which he was able to place an "x" on his map is legendary. Botanists and ecologists relocating some of his finds in later years after the use of GPS devices became routine, found that they could not mark his records any more accurately.

Mo's passionate interest in ferns deserves further mention. He was especially taken with fern hybrids, particularly the genus *Dryopteris*. He corresponded with well-known pteridologists Herb Wagner, Charlie Werth, and Murray Evans among others, supplying them with specimens and seeking their assistance in naming some puzzling specimens. Whenever a chance presented itself, he took both professional and amateur botanists to some of his favorite populations, rarely coming away without collecting more fronds himself which he sent to other herbaria in the region.

Mo was a prolific collector of all kinds of vascular plants, most of which he sent to Alton Harvill at Longwood College (later Longwood University) where a notable collection was being amassed. During his peak collecting years, he was also running regularly which became a cause of concern as mentioned in a letter to Alton Harvill:

> "My field work stays apace of recent years, but my identification & labeling has bogged down, & I have a huge accumulation of plants stacked around the house. At least our insulation is good. The reason is that when I come home from running 6-10 miles a day after work I eat supper & then have little energy

> except to read until bedtime. Meanwhile my correspondence & plant cataloguing languish. I have got to get going soon. (CES to AMH, June 13, 1975)"

Every visitor to the Stevens home at 615 Preston Place recalls the floor and dining room table stacked with plant specimens, plant manuals, maps, and his collecting ledger laid about, the space completely unusable for its otherwise intended purpose. If you stayed for dinner, you would join him and Toddy in the living room with your dinner on your lap, his good wife trying over and over to turn the conversation in a different direction with temporary success at best. He meticulously recorded his collections in ledgers, his numbers being in excess of 27,000 by September 1997, his last entry. The zeal for collecting did not diminish, however, and he continued to collect specimens for another ten years! His contributions to the herbarium at Longwood were so numerous and phytogeographically significant that the university eventually named the collection the Harvill-Stevens Herbarium at Longwood University. Mo also donated specimens to every major herbarium in Virginia and to others outside the state and region. In an introductory chapter of the Flora of Virginia, Dr. Donna Ware describes his efforts as follows:

> "The Atlas also benefitted from the extraordinary expertise and high-volume collecting of Charlottesville native Charles E. (Mo) Stevens, who, though not a botanist by profession, brought to his explorations a keen eye for topography and insatiable curiosity about plants. Famous for letting suggestive place names, geologic formations, and topographic signals lead him to botanical hot spots, Stevens bought 7.5' topo quadrangles of the state and walked, climbed, or crawled into some of the most formidable habitats and inaccessible regions in Virginia." (Weakley et al., 2012).

Mo's collections included scores[1] of species new to Virginia, and in correspondence, Alton Harvill, in typical dry humor, bemoaned the fact that Mo was rapidly making his maps obsolete.

Alton Harvill and Mo Stevens near Cressy Creek, Sugar Grove, Smyth County, Virginia, December, 1975. Photo by Doug Ogle.

When Mo got interested in a particular plant species, his searches were nearly exhaustive. Two such species that come to mind are exemplary - paper birch[2] and Porter's reedgrass, *Calamagrostis porteri.* Mo found paper birch in Albemarle County early on, and with it a population of Canada bunchberry, *Cornus canadensis*, a rare northern species previously unrecorded in Virginia (Stevens, 1968). This sparked a search for more birches which he quickly discovered were associated with talus and scree slopes on Erwin Quartzite along the western flank of the Blue Ridge. He also discovered that the white bark of these trees could be spotted through binoculars from more than a mile away in winter. Unencumbered by collecting during the off-season, he would take very long, all day walks, sometimes accompanied by a friend, scanning the opposing slopes for birch populations. His telltale collections from these explorations consisted of a winter twig and a swatch of the unmistakable bark. He eventually mapped out every population in the Blue Ridge of Virginia and a few in the Alleghany ridges to the west. He left unfinished a nearly complete manuscript detailing the distribution and ecology of this species at or near the southern limits of its distribution in the eastern United States (an effort

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[1] "scores" was a favorite word that Mo used frequently on his specimen labels.

[2] The scientific name for our white-barked birches is somewhat controversial and unsettled. Mo referred to paper birch as *Betula papyrifera*, though genetic studies later suggested that there were two species, and that birches in our region were *Betula cordifolia* instead. This problem is still under study.

Mo Stevens at paper birch station on the north side of Trayfoot Mountain, Rockingham County, Virginia, February 14, 1976. Note his characteristic winter attire. Photo by Gordon Webster.

is underway to publish this important work posthumously).

Calamagrostis porteri is a species that often forms extensive, non-flowering clones in the mountains of Virginia. When Mo learned of its identity, A.B. Massey's Virginia Flora (Massey, 1961) listed the species with the notation "G.M.8" indicating that Virginia was within the general range as described in Gray's Manual, 8th edition, no specific counties being known for Virginia. To make it more intriguing, the species appeared on a list of potential endangered species for the Northeast Region by the US Fish and Wildlife Service, Endangered Species Program (Ripley, 1975). Apparently, the species was largely overlooked due to its infrequent flowering and display of identifying features. Mo soon learned to recognize it in vegetative condition and proceeded to document the species from nearly every mountain county in the state. He also made a point of walking south along Cumberland Mountain in the hopes of finding it new to Kentucky. It took more than one trip, however, to secure the flowering material that he figured would be necessary to convince Kentucky botanists. He once told me that, if I came back to my car while out botanizing and found a vegetative stem of *Calamagrostis porteri* tucked under my windshield wiper, I would know that he'd been by. He got just that chance some years later when we were on a fern society foray to northern Alabama. Mo was up early eager to get out and explore the acid ridgetops of Cheaha State Park. When I ventured out sometime later wondering where he'd gone, there was the grass tucked under my windshield wiper, a new record for Alabama!

Mo was particularly keen on discovering the eastward distribution of montane species that dribble out onto the Piedmont from their mountain stronghold. This interest was likely sparked by an article published in the *Journal of the Elisha Mitchell Scientific Society* by James W. Hardin and Arthur W. Cooper in 1967 entitled, "Mountain Disjuncts in the Eastern Piedmont of North Carolina." Not only did Mo correspond with Dr. Hardin about some of these records, but tucked inside the issue where the article appeared was his own list of Virginia mountain disjuncts dated 10-31-74. In addition to north slopes of small Piedmont mountains, Mo also walked many miles of its rivers and creeks checking north-facing bluffs where such outliers were to be found. He loved to talk about this and compare notes. His recall of exactly where the easternmost populations of many species could be found was legendary among field botanists.

Other notable species on the Piedmont, such as scrub oak, occurred more locally and were found more by serendipity than anything else. The following illustrates his fascination with this species, as well as the fact that such distribution patterns had been noticed 200 years earlier by Thomas Jefferson.

> "That's interesting that Jefferson didn't miss the *Quercus ilicifolia* - in fact, apparently he didn't overlook much of anything. I never saw scrub oak in downtown Milton [eastern Albemarle not far from Shadwell, home of Jefferson's father, Peter Jefferson], but it's scattered along the roadbanks by the Milton airport, the bluffs of an adjacent creek, & S along the road to Nix. Also the Buck Island Creek "barrens" is probably a reference to the population along the side of rte #53 E of Nix and .9 mile N of the Buck Is. Creek bridge. This knowledge was gained in spite of not hanging around Hierom Gaines' shop." (CES to TFW, March 3, 1981)

Mo belonged to a number of botanical organizations which he joined, in large part, to subscribe to their journals. He generally purchased a lifetime membership. He was also a member of the Jefferson Chapter of the Virginia Native Plant Society which he joined in 1990 (Phil Stokes, pers. comm.).

ANECDOTES AND RECOLLECTIONS OF THE NATURALIST

Mo Stevens' interests in natural history were diverse, and he made anecdotal observations of all sorts of organisms. He became a member of the Virginia Natural History Society in 1993, the year following its formation as an organization.

As has been said before, Mo Stevens was well-liked by all who had occasion to spend time with him. He was an eager explorer, always ready to get out into the field. As with anyone who is passionate, he was not without some idiosyncrasies, but in his case they were more amusing than annoying. In his later years, Mo made many trips, especially to Southside Virginia with retired forest pathologist, Tom Dierauf, who shared the following recollection.

> "Mo had an unusual, often wry, sense of humor, and was constantly commenting on things he saw. He also had a number of amusing habits. He was addicted to Doctor Pepper - I'm not sure I ever saw him drink water in the field. He had a small, beat up cooler chest in which he carried his Doctor Pepper and a sandwich that Toddy made for him. His cooler was just long enough to accommodate 20 ounce bottles of Doctor Pepper, and when the company discontinued this size bottle it presented a crisis for Mo. I remember spending considerable time driving him around looking for stores that still carried this size bottle, and when he found a store in Dillwyn that had them, we made many trips there. The final solution was to buy the big bottles but pour them into 20 ounce bottles that he had saved. Even after his stroke, Mo could often be found at home nursing a glass of Doctor Pepper." (TD, pers. comm., 1-27-2016)

Also from Tom Dierauf:

> "The loggers were fascinated by Mo. The only reason most of them went into the woods was to cut trees or hunt, and the idea of a grown man, dressed in a sports coat, walking in the woods all day looking for plants seemed a bit strange. At the same time, they liked Mo and tried to be helpful, telling him where he might find wetlands, seepy areas, unusually big trees, and so forth." (TD, pers. comm., 2010)

Mo often wore a tweed sports coat in the field, especially in cooler weather, sometimes also with a thin, crew-neck sweater underneath. This was a bit unusual for this day and time, but it probably seemed natural and practical for a former fraternity man at The University, especially since his father managed an elite men's clothing store on the Corner (the Stevens-Shepherd Company) directly across the street from the UVa central campus where coat and tie was standard attire. "Old school" manners were also important to him. He always appreciated it when younger people addressed him as Mr. Stevens and answered, "Yes, sir" to his inquiries. But he wasn't at all pretentious and quickly dropped the formalities around his birding and botanist colleagues. But he clung to old ways while they were still practical. When gas stations first started the practice of self-serve, he would drive across town to fill up the tank at a gas station where they still pumped the gas for you and cleaned your windshield. As times changed, prices and the cost of services increased. He thought about this a lot, I found, when he asked me what cost had, in my opinion, gone up the most over the years. His well thought out opinion was a haircut which he figured now cost something like 20 times what it had from his earliest memory.

Words and their proper use were important to Mo, and his library included many dictionaries and other reference works on word use, historically and regionally. He never seemed to let the improper use of a word go by without comment, either in conversation or on paper. Place names and surnames were also frequent subjects of conversation. The following letter will illustrate this engaging and often humorous aspect of his personality.

> CES to Doug Ogle, Aug. 13, 1991
>
> Dear Doug,
>
> Congratulations! Your assiduous (pun intended) research paid off in tracking down the original & correct name of the now euphemized "Big A Mtn." It is interesting that my Oxford English Dictionary regards "ass" as vulgar & dialectual for "arse", but does not say that the latter is so. "Arse" comes from Teutonic languages, and even Greek & Hittite, with a citation from English writing as late as 1880. My Random House Dictionary considers "arse" slang or vulgar, even if the British don't.
>
> Evidently "political correctness" came to the U.S. Geological Survey early this century. I wonder what oldtimers in the Buchanan-Tazewell area called the mountain? We shall have to form a committee to bring back the older name.
>
> Keep up the good research, & thanks for your note.
>
> Best regards,
> Mo

[An older edition of the 15′ topographic map shows "Big Arse Mountain" whereas later 15′ maps refer to the same feature as "Big AMountain".]

Mo's legacy will reside in his thousands of bird records and plant specimens, but while memories last, his zeal for exploring will be cherished by his field companions. To give a better sense of Mo's enthusiasm, a few more excerpts may be instructive. Chip Morgan, an ophthalmologist who took up natural history as a retiree, and who took Mo all over the countryside during the last decade of Mo's field days, has the following recollection.

> He would go anywhere as long as it was in the woods. Tough terrain was no problem. Don't let Mo out of sight because it is your responsibility to hang on. Witness hunting white birch - scrambling down scree slopes, crawling under laurel, climbing any elevation. One had to be prepared for the challenge because that is what you got. (CM, pers. comm., 2-01-2016)

Mo's correspondence provides additional examples of his exploits and the wonderful way he describes them. To wit:

> On the beautiful day that followed (Sunday) I climbed Elliott Knob [Augusta County] with Geo. St. John [Charlottesville lawyer]. We ascended via the eastern route (Falls Branch) to the summit rather than take the route from the north col, which was used by the ill-fated French party. Not establishing a base camp, we gambled & did not take crampons for the first icefall. However, it turned out that we didn't need them after all. The downed timber was hell to negotiate, though. (CES to TFW, 5-04-1980; note added)

> Last Saturday (June 21) I got in the mail, from Janet Partridge of the Nature Conservancy, a copy of a Unique Ecosystem Report on Panther Knob, along with a copy of Core's 1952 Wildflower article. Receipt of this, plus outstanding weather, caused me to cancel my previous trip plans for the next day & substitute Panther Knob. After the fairly short, but strenuous, ascent from the gap on the W side I made the summit of the knob and met with a big black rattler in the open rocks by the fallen triangulation tower, & was rattled at. This encounter caused me to mince around the huckleberries for a while, but I soon got my old bravado back & was crashing & blundering as usual.... Like Core's party, at one point I had to resort to tree climbing to get my bearings, however, I couldn't see over the other vegetation, So I had to dismiss the spectors of Frog Level & Riven Rock & trust my built in compass, which turned out to be adequate [reference to localities in Caroline and Highland counties where CES & TFW had gotten sufficiently "turned around" to be quite memorable!]. (CES to TFW, 6-27-1980; note added)

While birds, plants, geology, and phytogeography were Mo's primary interests, he also made anecdotal observations of other natural history subjects.

> When I began pressing my Prince Edward plants at home in the living room last week, I noticed the *Chrysosplenium* move several times. Investigation of this peculiar activity revealed a tiny 1-inch salamander which I plopped into a juice glass of shallow water with a piece of paper napkin in it. I have since transferred him to less sterile & more agreeable quarters in another juice glass with a rock, two leaves & a modest amount of grit. At this point I have still not been able to identify it. He, or she, is sandy gray, has no lungs (which would probably be handy for running up hills) & is translucent. With a hand lens one can see his little red heart (104-107 beats per min.), his aorta & part of his G.I. tract. I hope the apparent lack of genitalia is no more of a handicap than the lack of lungs. (CES to TFW, 4-15-1982)

HONORS AND AWARDS

In recognition of his outstanding efforts and lifetime accomplishments, Mo was recognized on several occasions. As has been mentioned, his prolific herbarium specimens were sent primarily to Longwood College joining the equally numerous collections of Alton Harvill. In August 1985, the herbarium was officially named the Harvill-Stevens Herbarium honoring its chief contributors. Documentation of this event was signed by both men (Wells, 2015).

Mo was one of the recipients of the 1993 Donald and Minnie Windler Award presented to authors of the best systematic botany paper published in *Castanea* during the previous year, "Vascular flora of the James River Gorge watersheds in the central Blue Ridge Mountains of Virginia" (Ramsey et al., 1993).

In 2014, the Albemarle County Board of Supervisors recognized Mo for his lifetime achievements which benefited the county as well as the Commonwealth. The statement is reproduced below:

> Albemarle County Board of Supervisors Meeting,
> November 12, 2014
>
> ATTACHMENT 2
> RECOGNITION
>
> WHEREAS, Charles E. "Mo" Stevens has made many significant contributions to ornithology in Albemarle County, including his annotated checklist of birds of Albemarle County, which was a "milestone in ornithological history of Albemarle County" (The Birds of Albemarle County and Charlottesville Virginia, p. 1); and
>
> WHEREAS, Mo made remarkably extensive discoveries in botany in Albemarle and throughout the state, and added over 25,000 specimens to the Longwood Herbarium (now the Harvill-Stevens Herbarium) and was a significant contributor to the recently published Flora of Virginia (Flora of Virginia, p.19); and

WHEREAS, Mo's participation with the Biodiversity Workgroup, as well as his explorations and remarkably extensive notes, have been invaluable to the County by documenting many of our most special places and species; and

WHEREAS, Mo served as a mentor to some of the Commonwealth's most respected field specialists;

NOW, THEREFORE, BE IT RESOLVED, that the Albemarle County Board of Supervisors recognizes and honors the considerable life achievements of Charles E. "Mo" Stevens as a citizen, scientist and naturalist who has greatly deepened our understanding of the natural world in Albemarle County and the Commonwealth of Virginia.

Signed and sealed this 12th day of November, 2014.

ACKNOWLEDGMENTS

I would like to acknowledge generous personal communications from Tom Dierauf, Chip Morgan, and an anonymous individual. Their thoughtful recollections helped to "flesh out" the character traits of this remarkable man, and to stimulate my own personal recollections from the many days I was privileged to share with Mo exploring rock outcrops, forests, fields, swamps, and yes, plenty of rhododendron hells.

Thanks to Ryan S. Mays for providing citations of articles Mo published in *The Raven*, journal of the Virginia Society of Ornithology.

A special thanks to Mo's family for allowing access to his correspondence. These letters and those of other members of the Virginia Botanical Associates (VBA) are now preserved in the VBA Archive at the Albert and Shirley Small Special Collections Library at the University of Virginia.

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Appendix 1. Chronological Listing of the Publications of Charles E. Stevens

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Stevens, C. E., Jr. 1944. Blue Ridge notes--Madison and Page counties. Raven 15(9/10): 89.

Stevens, C. E., Jr. 1946. Dismal Swamp notes. Raven 17(7/8): 59-60.

Stevens, C. E., Jr. 1946. Notes on the fall migration at Charlottesville. Raven 17(11/12): 83-84.

Stevens, C. E., Jr. 1946. Yellow Warbler at Charlottesville. Raven 17(11/12): 84.

Steven, C. E., Jr. 1947. V. S. O. field trip 1947. Raven 18(5/6): 24-25.

Minor, W. F., C. E. Stevens, Jr., & J. H. Grey, Jr. 1948. Two winter bird censuses. Raven 19(5/6): 36-37.

Scott, F. R., & C. E. Stevens, Jr. 1948. A trip down the Chickahominy. Raven 19(7/8): 41-44.

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Lawless, K., & C. E. Stevens, Jr. 1948. Spring count, Charlottesville. Raven 19(7/8): 47-48.

Minor, W. F., F. R. Scott, & C. E. Stevens, Jr. 1948. Mount Rogers notes. Raven 19(9/10): 55-57.

Minor, W. F., F. R. Scott, & C. E. Stevens, Jr. 1948. Highland County notes. Raven 19(9/10): 57-59.

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Stevens, C. E., Jr. 1949. V. S. O. fall field trip to Back Bay. Raven 20(9/10): 55.

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Stevens, C. E., Jr. 1958. The Cerulean Warbler in Albemarle County. Raven 29: 119-121.

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Stevens, C. E., Jr. 1965. Confusing chickadee songs in the Shenandoah National Park. Raven 36: 37.

Stevens, C. E., Jr. 1965. Recent Winter Wrens in summer in the Shenandoah National Park. Raven 36: 48.

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Stevens, C. E., Jr. 1966. Invasion of Pine Siskins and other finches into the central Virginia Blue Ridge in winter of 1965-66. Raven 37: 81.

Stevens, C. E., Jr. 1967. Exploring the Beartowns. Raven 38: 16-18.

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[3] Alton Harvill is known to have sought assistance from Mo Stevens in writing the introductory chapters which appear in *Atlas of the Virginia Flora, Part 1* (1978). No authorship is indicated in the publication, but the familiarity with numerous places mentioned, coupled with the fact that he collected plants from all of them, strongly suggests that Mo Stevens authored the chapters on Physiography and Geologic History and Vegetation Types and Plant Communities.

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Miscellanea

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Obituary

John B. Bazuin, Jr. (1947-2016)

John B. Bazuin, Jr., of Annandale, Virginia, a longtime member of the Virginia Natural History Society (joined in 1994), died of pneumonia on 27 January 2016 at the age of 68. He is survived by two sisters, three nieces, two great-nieces, and a great-nephew. John was born on 20 August 1947 in Washington, DC and grew up in Great Falls, VA. He received his Bachelor of Arts and Master of Arts degrees in biology from the University of Virginia in 1969 and 1976, respectively. John spent most of his career as a pesticide action reviewer for the US Environmental Protection Agency, retiring in 2010. His previous positions included serving as an observer on Japanese long-line tuna boats to monitor compliance, record catch totals, and document sightings of marine mammals and turtles.

John had broad interests in natural history and was also a longtime member of several other societies, including the Virginia Society of Ornithology (member since 1973; society president, 1989-1991), Virginia Herpetological Society (member since at least 1979), Virginia Native Plant Society, Audubon Naturalist Society, Chesapeake Bay Foundation, and the Hawk Migration Association of North America. He was also interested in Civil War history and archaeology, and served as a volunteer for surface surveys and excavations at several prehistoric sites in eastern Virginia.

John was well-known among Virginia's birding community. He participated in many surveys and counts spanning several decades and frequently submitted observations that were included in state or regional compilations published in *American Birds*, *National Audubon Society Field Notes*, *North American Birds*, *The Raven*, and *Virginia Birds*. John led numerous birding field trips in Virginia and was a volunteer steward at the Bethel Beach Natural Area Preserve in Mathews County.

John published at least the following papers or notes related to Virginia's natural history:

1980. Some noteworthy bird records from Louisa County, Virginia, from 1974 to 1979. Raven 51(4): 59-64.

1983. Reptiles and amphibians of the dioritic section of the Green Springs igneous intrusion, Louisa County, Virginia. Catesbeiana 3(1): 13-16.

1990. Upland Sandpipers in northern Loudoun County, Virginia - history and 1989 research. Raven 61(2): 55-65.

[Bazuin, J. B., Jr.]. 1990. Northern Harrier nests in Mathews County. Raven 61(2): 87.

1991. Northern Harrier. Pp. 496-497 *In* K. Terwilliger (coordinator), Virginia's Endangered Species: Proceedings of a Symposium. McDonald and Woodward Publishing Company, Blacksburg, VA.

1991. Upland Sandpiper. Pp. 504-505 *In* K. Terwilliger (coordinator), Virginia's Endangered Species: Proceedings of a Symposium. McDonald and Woodward Publishing Company, Blacksburg, VA.

1992. The Wilson's Storm-Petrel in Chesapeake Bay. Raven 63(1): 3-14.

1992. The Jackson Miles Abbott Wetland Refuge. Raven 63(2): 103-104.

1994. Field Notes: *Gastrophryne carolinensis* (Eastern Narrow-mouthed Toad). Catesbeiana 14(1):13.

1997. Eastern Narrow-mouthed Toads (*Gastrophryne carolinensis*) in Mathews County, Virginia. Catesbeiana 17(1):17-20.

1997. Site 15. Lake Anna, Louisa, Spotsylvania, and Orange counties. Pp. 117-119 *In* D. W. Johnston (compiler), A Guide to Bird Finding in Virginia. American Birding Association, Inc., Colorado Springs, CO.

1998. First Herring Gull nest on the Virginia Western Shore. Raven 69(1): 39-43.

Prepared by Steve Roble, Editor, *Banisteria*

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Obituary

Robert B. Lyon (1920-2015)

Robert B. "Bob" Lyon, of Purcellville, a member of the Virginia Natural History Society (VNHS) since 2006, died of heart failure on 19 August 2015 at the age of 94. A civil engineer with a degree from Virginia Tech, he was born on 7 September 1920 and served in both World War II (as a Navy fighter pilot) and the Korean War. He was a generous supporter of the VNHS, purchasing a lifetime membership in 2012 at the age of 91, as well as guest memberships for several friends and family members. In retirement, Bob pursued lifelong interests in ornithology, botany, and entomology. He developed a keen interest in the Lepidoptera of Loudoun County, became the local expert, and founded an annual butterfly count there in 1997. He also photographed thousands of local moths and meticulously organized the color prints in a series of albums, each photo labeled with the date and species identification. Bob also frequently assisted his late friend William R. Grooms (1947-2012) in collecting moths at various sites in the county, typically from the walls of buildings at shopping centers late at night.

I first met Bob at a VNHS-sponsored bioblitz held at Douthat State Park on a cold, rainy weekend in May 2003 when we captured very few moths. On many subsequent occasions, he sent me photos of moths to identify or verify (usually as self-addressed return postcards, sometimes labeled "Help!!!"), or handwritten cards and letters inquiring about the taxonomic status of a particular species or noting possible omissions from my unpublished checklist of Virginia macromoths. The arrival of each card or letter was a source of suspense to me and several coworkers. Following Grooms' death, Bob made a special effort to save that collection from being discarded and later turned it over to me; it contains a number of important records. At the time of his death, Bob was writing a field guide to the moths of Loudoun County, a project that fellow members of the Loudoun Wildlife Conservancy intend to complete.

Bob was known as Loudoun County's "Sign Cop" because of his years-long campaign to remove illegal cardboard signs (he personally collected nearly 30,000) that littered the roadways of his community. Survivors include his wife Jody of 68 years, three children, two sisters, six grandchildren, and two great-grand-children. Two children and a grandson predeceased him.

Prepared by Steve Roble, Editor, *Banisteria*

Reports

1. President's Report

It has been a pleasure and an honor to serve as President of the Virginia Natural History Society (VNHS) during the past two years. I encourage others to travel this path to service by letting the Society know of your willingness to assist with this great endeavor. Service as a councilor is a great way to learn more about the operations of the Society and to meet the other committed men and women who give visibility to natural history studies in Virginia. The Society continues to provide its members and the public with a unique resource by publishing *Banisteria*. I can't overstate the value of this journal or give enough praise to the worthy authors, reviewers, and editors who have sustained it over the past 24 years. VNHS members can enjoy knowing that our financial and intellectual support is critical for the future well-being of this organization. VNHS is unique in its eclectic mix of natural history interests and *Banisteria* stands alone as a peer-reviewed repository of these studies and observations.

It is with great satisfaction to see that the efforts of so many people can now be accessed electronically without charges. The VNHS website, http://virginianaturalhistorysociety.com, allows anyone to review the contents and abstracts of the past 45 editions of *Banisteria*, and for an ever-increasing number of articles, to download the entire article as a searchable PDF document. I express my gratitude to the three people currently most responsible for this public offering: our editor Dr. Steven M. Roble, past president Tom McAvoy, and webmaster John White. They and several others in the Society have made this transition from print to electronic format a reality. I encourage you to allocate an evening for a look back on what has filled the pages of *Banisteria* in the past. You will see that *Banisteria* has met its goal to publish excellent articles covering Virginia's biodiversity. I encourage new authors to continue this tradition and expand content to better cover archeology, anthropology, evolutionary history, climatology, and physical resources of the state.

I have been humbled by the Society allowing me to serve as President as my continuing work with Virginia Cooperative Extension has not allowed me to claim title as a professional naturalist. My work in Nelson County is focused on production agriculture and applied ecology as it relates to crop protection. I augment my work week with getting out into the field and serving as an advisor for the Central Blue Ridge Chapter of the Virginia Master Naturalists. I also serve the Virginia

Master Naturalists by sitting on its statewide advisory committee. My love of entomology and friendships with Drs. Michael Kosztarab and Richard Hoffman, who authored many past articles in *Banisteria*, were my segue to becoming a part of VNHS. The Society has since been an ongoing pleasure for me as I meet more and more people who share a passion for local natural history. I charge you to be a similar initial point of contact for others. Encourage people you know to read *Banisteria* and support VNHS by becoming a member.

Respectfully submitted,
Michael Lachance, President
Virginia Natural History Society

2. Minutes of December 2015 Executive Committee Meeting

The 2015 meeting of the Executive Committee of the Virginia Natural History Society was called to order by President Michael Lachance at 1:20 PM on December 5, 2015 in Gilmer Hall at Hampden-Sydney College (HSC), Hampden-Sydney, Virginia. In attendance were Michael Lachance, Ralph Eckerlin, Steve Roble, Chris Milensky, Paul Marek, and Rachel Goodman.

The minutes of the 2014 meeting and the report of the Secretary/Treasurer were approved unanimously. A current report is appended to these minutes.

There was discussion of the Secretary/Treasurer's report, and Roble expressed concerns about the large numbers of members not renewing. The lack of *Banisteria* issues and newsletters in 2015 was discussed and a potential timeline of issues for 2016 was presented. Rather than trying to catch up members with 2015 and 2016 memberships by delivering 4 issues of *Banisteria* in 2016, Lachance presented an alternate option. The Council agreed to invite members from 2015 to select 2 back issues for delivery to make up for the lack of issues delivered in 2015.

Beckie Smith, who has long assisted the Secretary/Treasurer's activities at HSC, will inventory all back issues of *Banisteria* and process the requests from society members. In January, Goodman will email the current membership with a notice that *Banisteria* No. 45 is coming soon, that members can select 2 back issues of *Banisteria*, and information for dues renewal for 2016. We also discussed setting up an online payment option for dues in the future and sending new members an email confirmation of their membership. Also, Roble may re-format the last page of the journal to advertise free membership for high school, undergraduate, and graduate students (must be nominated by advisor/teacher and approved by the Council).

Steve Roble presented the Editor's report. *Banisteria* No. 45 is expected to be printed in December and mailed in January 2016. Content was presented for issues No. 46 and 47 which should be published in 2016. Lachance suggested that some obituaries from *Banisteria* should be published on the website.

The council discussed content moving online for *Banisteria* in coming years (replacing paper journal). Benefits would include lack of publishing costs and ability to provide higher quality and color photos. However, some council members discussed enjoyment of paper journals that cannot be replaced with PDF copies. Maybe having both would yield the best of both worlds.

VNHS was founded in 1992, and the silver anniversary will be in 2017. In the first two years only 1 issue of *Banisteria* was published each year. In all years since then until 2015, 2 issues have been published per year. Roble has now served as Editor of *Banisteria* for 16 years. He plans to continue through publication of issue No. 50 in spring 2018, at which point a successor will be necessary.

The majority of *Banisteria* back issues through 2011 have been scanned, proofread, and posted online. This project continues, with 64 articles left to be posted from 2011 or earlier. Also, articles up to No. 42 will now be included and posted.

Mike Lachance presented the President's report. Two main questions he presented: What is the identity of VNHS? How can we broaden opportunities for participation of younger scientists and others involved in natural history activities?

Several changes to the by-laws were unanimously approved by the Council, to bring the language in line with the current practices of the society. Eckerlin will revise the by-laws and circulate the updated file to the Council.

Marek volunteered to be the Newsletter editor. Roble is going to email him the past newsletters for guidance. Lachance wants to write an article and suggests profiles of new councilors. Roble suggested profiles of state natural areas or parks, species profiles, or project summaries from Virginia Master Naturalists. Ideas to enhance membership and outreach were suggested: a trifold brochure, a big poster for Master Naturalist events or other meetings, and pens with the society name and website. Lachance suggested coordinating with James River State Park, which has expressed interest in having more volunteers and programs in natural history. Council members suggested more (co-) sponsorship of symposia and bioblitzes.

The meeting adjourned at 4:15 PM.

Respectfully submitted,
Rachel M. Goodman, Secretary/Treasurer

3. Secretary-Treasurer's Report

As of June 13, 2016, the society has 79 members, including 12 institutions. This represents a decline in membership, with 105-127 members recorded in December during 2010-2014. In 2015 the society had 95 members, including 14 institutions.

Our current bank balance is $13,408.44, up from $12,686.68 in November 2015.

Respectfully submitted,
Rachel M. Goodman, Secretary/Treasurer

4. Webmaster's Report

The society's website now contains searchable pdf reprints of all papers published in the first 41 issues of *Banisteria* (1992-2013). All obituaries published in *Banisteria* are also posted on the website, as are the abstracts of full papers published since 2013.

VNHS website traffic during the past year is summarized in the following table:

Month	Visits	Pages	Files	Hits
Jun 2016	994	1893	8909	11828
May 2016	1131	2169	9869	13550
Apr 2016	1058	1916	9166	12759
Mar 2016	1127	2021	9665	12908
Feb 2016	1212	1906	12855	16045
Jan 2016	1320	2460	8518	12240
Dec 2015	1263	2120	9987	14305
Nov 2015	1256	2691	10166	14521
Oct 2015	1257	2596	10720	15558
Sep 2015	1236	2877	8683	13519
Aug 2015	1239	2139	12003	16101

Respectfully submitted,
John White, Webmaster

5. Editor's Report

The Historical Contributions section of this issue of *Banisteria* contains an atypical paper for the journal that connects biology, land use history, and military history. I hope it will be of interest to many of you.

In response to a suggestion from a member, I have changed the format of the Shorter Contributions section of *Banisteria* beginning with this issue such that the title now appears on a separate line, followed by the names and addresses of the authors. Hopefully, this will increase the likelihood that these articles are captured by websites such as Google Scholar and help make *Banisteria* known to a wider audience.

I still need additional material for the next issue of *Banisteria*, so please consider submitting a paper, note, biography, historical contribution or book review concerning the natural history of Virginia.

Respectfully submitted,
Steve Roble, Editor, *Banisteria*

Announcements

News of Members

Dr. Barbara J. Abraham, Associate Professor of Biology and SEEDS (an Ecological Society of America program designed to increase representation in the field of ecology by members of underserved minority groups) Faculty Advisor at Hampton University, retired in May 2016 after 31 years at that institution. Barb has been a member of the Virginia Natural History Society since its inception and served as President from 2003-2004. She conducted research on spiders in Utah, Iowa, Kentucky, and Virginia for about 30 years before switching to native bees during the past decade "due to growing interest in what was buzzing around in a native plant garden" she had established on the Hampton University campus. We wish her well in her future endeavors.

Student Membership Incentive

Recognizing that students interested in natural history represent the main pool of prospective future members of the Virginia Natural History Society, the Executive Committee of the Society is soliciting nominations from our members for a **free one-year membership in the Society** to selected college, university, and high school students. We believe that receiving this membership will make more students aware of the Society and appreciate the benefits of continued membership. The Society will fund up to twenty students in 2016. Nominees should be undergraduate or graduate students at a college or university in Virginia, or outstanding high school students, who are particularly interested in natural history. Nominators should be members of the Society and provide the following information for up to three students: Name, institution, mailing address, e-mail address, and a short paragraph describing the students' interests in and activities related to Virginia natural history. Nominations should be sent to the Secretary-Treasurer, Rachel Goodman at rgoodman@hsc.edu.

Virginia Natural History Society

http://virginianaturalhistorysociety.com/

General Information

The Virginia Natural History Society (VNHS) was formed in 1992 to bring together persons interested in the natural history of the Commonwealth of Virginia. The VNHS defines natural history in a broad sense, from the study of plants, animals, and other organisms to the geology and ecology of the state, to the natural history of the native people who inhabit it. The goals of the VNHS are to promote research on the natural history of Virginia, educate the citizens of the Commonwealth on natural history topics, and to encourage the conservation of natural resources.

Dissemination of natural history information occurs through publication of the journal *Banisteria*, named for John Banister (1650-1692) who was the first university-trained naturalist to work in Virginia. The first issue was published in 1992, and the journal is published twice per year in spring and fall. Articles cover a wide array of subjects, and prospective authors are encouraged to submit manuscripts on any aspect of natural history in Virginia; papers may pertain to Virginia or regional archaeology, anthropology, botany, ecology, zoology, paleontology, geology, geography, or climatology. Book reviews, biographies, obituaries, and historical accounts of relevance to natural history in Virginia also are welcomed. Manuscripts are peer-reviewed for suitability and edited for inclusion in the journal.

Page charges ($20/page) are waived if the sole or first author is a VNHS member. All authors must pay $75/page if they desire color printing of figures. The society's website contains detailed instructions for authors and the titles, abstracts or full PDF versions of articles from past *Banisteria* issues.

Memberships

The VNHS is open to anyone with an interest in natural history and welcomes participation by all members in society activities and efforts to promote education and conservation. Membership includes a subscription to *Banisteria* and invitations to periodic symposia and field events. Annual dues for members are $20 (per calendar year); library subscriptions are $40 per year. Checks should be sent to the Secretary/Treasurer, who also has most back issues of *Banisteria* available for sale. The VNHS is a tax-exempt, nonprofit, society under Section 501(C)3 of the IRS. We welcome donations to support our mission in Virginia.

Virginia Natural History Society

Application for Membership

Name ______________________________

Address______________________________

____

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Zip Code ___________________________

Phone ______________________________

Email ______________________________

Area(s) of Interest ______________________

ANNUAL DUES AND SUBSCRIPTIONS TO *BANISTERIA*

(memberships and subscriptions are by calendar year; subscribers/members outside the United States should add $3.00 for additional postage)

- ☐ $500.00 Life (not annual)
- ☐ $300.00 Benefactor
- ☐ $100.00 Patron
- ☐ $50.00 Supporting
- ☐ $40.00 Institutional
- ☐ $25.00 Family
- ☐ $20.00 Regular
- ☐ $5.00 Student (see below)
- ☐ I have added a contribution of $______ to my membership dues.

The special student rate is applicable only when accompanied by the following certification signed by a faculty advisor (students are also eligible for a 1-year free membership if an advisor's nomination is approved by the society's Executive Committee; see nomination guidelines in *Banisteria*).

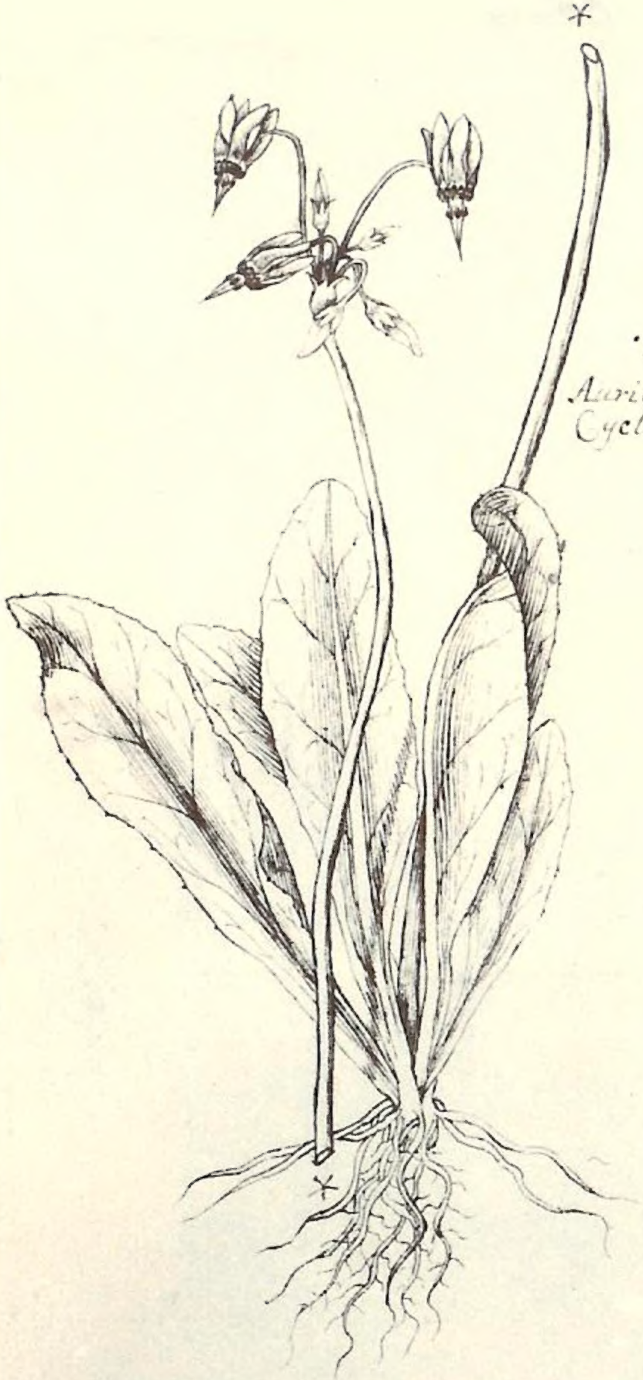
Institution ___________________________

Advisor ____________________________

Date_______________________________

Make checks or money orders payable to:
Virginia Natural History Society

Send membership form and dues to:
Dr. Rachel Goodman, Secretary-Treasurer
Virginia Natural History Society
Box 74
Hampden-Sydney, VA 23943



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made so much too long.

·5

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Cyclamineorum more reflexis.